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OF THE

AMERICAN ASSOCIATION OF NURSE ANESTHETISTS

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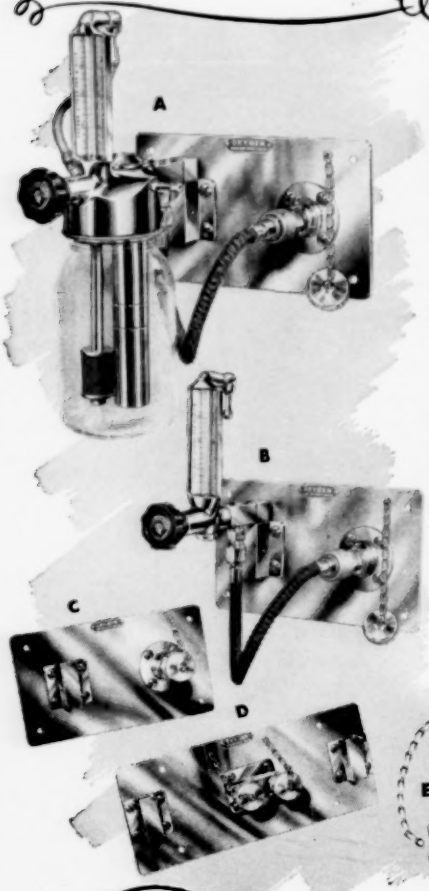

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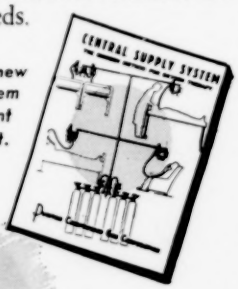

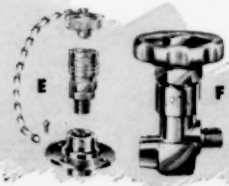

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1. Goodman, L., and Gilman, A.: *The Pharmacological Basis of Therapeutics*, New York, The Macmillan Co., 1947, p. 58.

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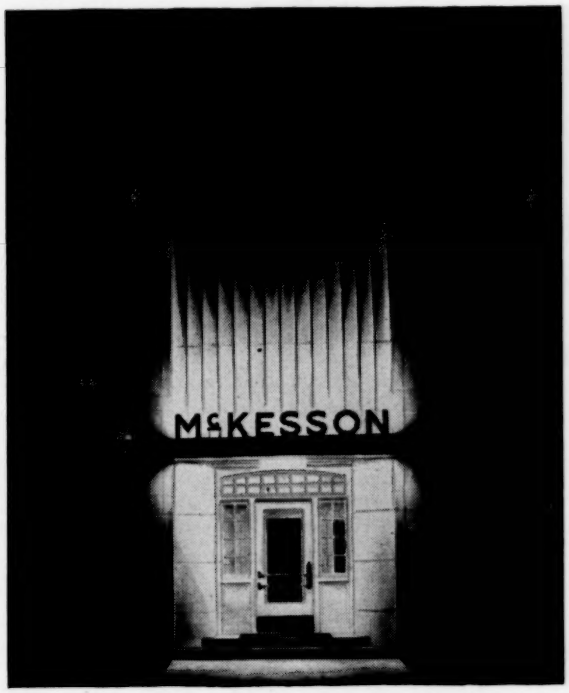

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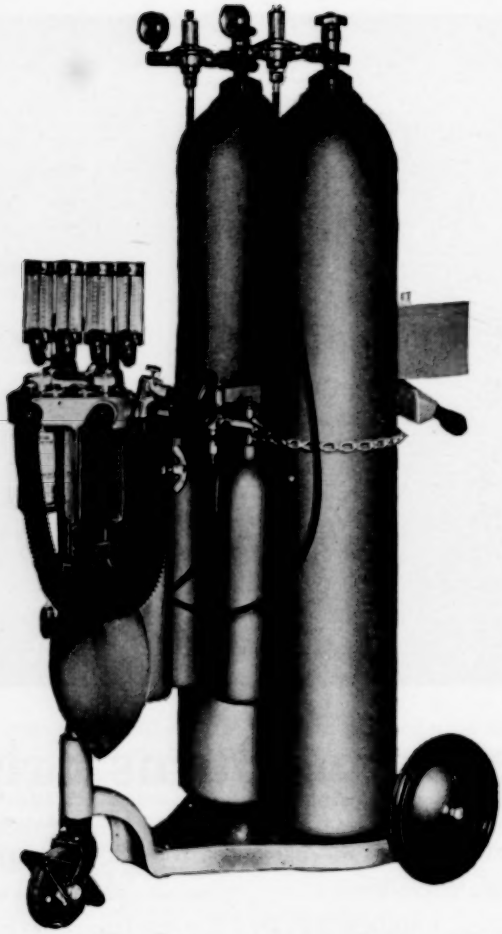

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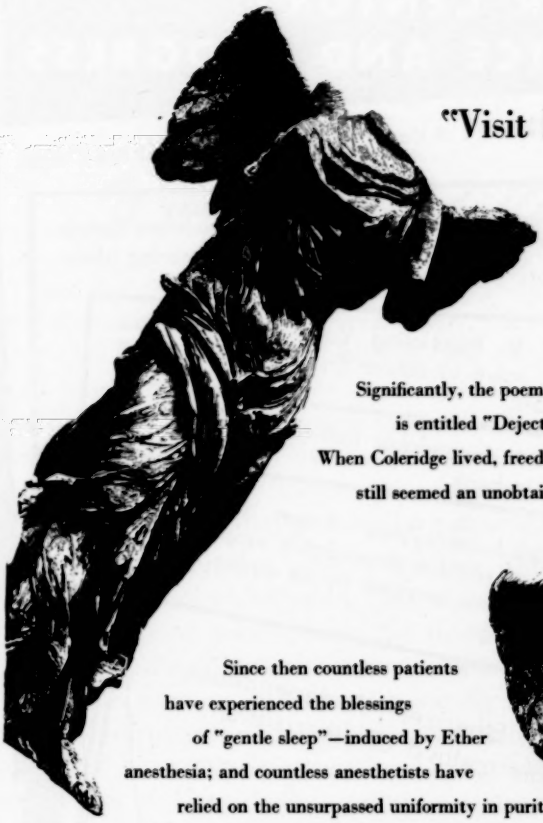
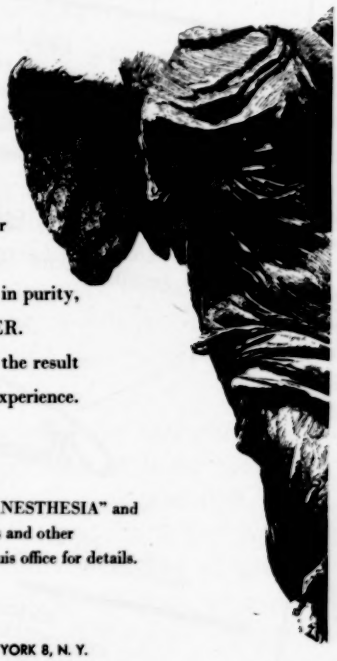


"Visit her, gentle sleep!
With wings of
healing"

COLERIDGE (1802)

Significantly, the poem in which this line appears is entitled "Dejection." When Coleridge lived, freedom from pain still seemed an unobtainable goal.



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The Journal of the American Association of Nurse Anesthetists

VOLUME XVII NOVEMBER, 1949 NUMBER FOUR

It was a Grand Convention

Just the time of year of the annual meeting, something happens as the foliage matures: the green fades to show the red and russet and yellow hues that were there all the time. Earlier, the masses of green, seen from a distance, give little indication that there stands an oak or that that maple is a sugar maple and is different from another that stands farther up the hill. But when the green goes—when the color of youngness fades—the red sumac, the yellow maple, and the russet oak proclaim their mature individuality.

At the Sixteenth Annual Meeting this year, the Association showed just such individuality among organizations of nurses. The resolution passed unanimously at the business session condemning federal compulsory health insurance placed the Association in the vanguard of nursing organizations taking a stand on such legislation. Upon the recommendation of the Board of Trustees, the resolution was placed before the membership for decision. What other organizations had or had not done in taking a stand may be said to have had little if any influence on the action of the A.A.N.A. The resolution was passed solely on the basis of principles, not of pressures nor of benighted self interest.

During the business sessions, the forums, and discussion periods, there was evident an eagerness to inquire and to learn and to contribute to the common good, and it was quite apparent that the A.A.N.A. is an organization of persons with distinct characters who insist on the right to think and speak as individuals. If any single phrase could be selected as a keynote of the meetings, it was, as a member speaking from the floor so aptly put it: "It's still a free country, isn't it?"

Those who could not attend missed a grand convention; those who were fortunate enough to be there had reason to go away impressed with the ability of nurse anesthetists to express themselves through an organization that has reached maturity.

ANESTHESIA FOR PLASTIC SURGERY

W. G. Hamm, M.D., F.A.C.S.
Atlanta, Ga.

Anesthesia for plastic surgery has become a somewhat specialized field. With improved technics of surgery have come improved technics of anesthesia. The meticulous work of the plastic surgeon, which is often time consuming, necessitates ideal operating conditions. Every effort is made to suit the anesthesia to the particular type of operation. Much progress has been made in the past ten years in the field of plastic surgery; whereas previously plastic operations were at times extremely hazardous, they can now be done with ease by the surgeon and with safety to the patient. This improvement has come about through the introduction of intratracheal anesthesia, which, as we know it today, was achieved through the efforts of Magill and Rowbotham, anesthetists serving with the British Army Plastic Unit during World War I.

Anesthesia for plastic surgery varies from the simple to the very complex. No single method can be advocated for all operations. Perhaps no other field of surgery necessitates more technical versatility in management. The anesthetist must be familiar with the working conditions required by the surgeon and the complications and sequelae peculiar to any specialized type of surgical procedure. Patients undergoing plastic surgery are usually in good general health but are often faced with a series of operations spread over a long period. It is wise to make the initial anesthesia as smooth and as pleasant as possible. Ideally one should strive for a smooth, swift induction, even maintenance, and a quiet recovery, rapid and free from nausea and vomiting.

The fundamental principles involved in plastic surgery were emphasized by Gordon and Apgar[1]: (1) no distortion of the operative field, (2) no increase in bleeding, (3) maintenance of normal muscle tone, (4) pleasant induction, (5) smooth recovery, (6) no encroachment on the operative field by the anesthetist, and (7) the lightest plane of anesthesia consistent with good operating conditions.

Some of the plastic operations will be itemized and the different methods of management discussed with emphasis upon the advantages and disadvantages.

Preoperative Preparation

Since the majority of plastic operations are elective, the patient should come to the operating room in the best possible condition. He should be admitted to the hospital the night before operation. A thorough physical examination, blood count, urine

Read before the Southeastern Assembly of Nurse Anesthetists, Biloxi, Miss., April 29, 1949.

1. Gordon, R. A.: Problems of anesthesia in plastic surgery. Anesthesiology **3**:507-513, Sept. 1942; Apgar, Virginia: Principles of anesthesia in plastic surgery. S. Clin. North America **24**:474-479, April, 1944.

PREANESTHETIC MEDICATION FOR PLASTIC SURGERY

AGE	ATROPINE OR SCOPOLAMINE	MORPHINE OR PANTOPON
Up to 18 mo.	Nothing	Nothing
18 mo. to 3 yr.	1/450 gr.	Nothing
3 yr. to 5 yr.	1/300 gr.	1/24 gr.
5 yr. to 10 yr.	1/200 gr.	1/12 to 1/8 gr.
10 yr. and up	1/150 to 1/100 gr.	1/6 to 1/4 gr.

examination, and, when indicated, blood typing and cross matching should be done. Whenever possible, the anesthetist should visit the patient before the operation and leave the preanesthetic orders. In this way preanesthetic medication can be individualized after the anesthetist has decided upon the type of management and evaluated the risk involved. Furthermore, an attempt may be made at this visit to gain the patient's confidence and to determine his temperament, personality, and personality changes, if any.

PREANESTHETIC MEDICATION

A barbiturate, nembutal or seconal, gr. 1½, should be given the night before operation to insure a good night's sleep. It is mandatory that the patient have nothing by mouth for six to eight hours before going to the operating room. Preanesthetic medication should be administered forty-five minutes to one hour before the patient is taken to the operating room. The table of doses may be varied according to the age, size, apprehension, and general health and physical status of the patient. Under no circumstances should premedication be omitted except when the patient is very young.

PEDIATRIC ANESTHESIA

Since a great number of plastic procedures are performed on children, the age factor will in many instances determine the choice of anesthetic agent, while the technic will be determined largely by the site of operation. In general, it is not considered wise to use the intratracheal method for children under 2 years of age except in unusual circumstances, because of the small lumen of the trachea and the danger of trauma to the vocal cords with resultant edema and obstruction. Intubation of children should always be done with a minimum of trauma.

Ether is the anesthetic of choice for children. Cyclopropane may be used with safety for children over 4 years of age. Children appear to be more susceptible than adults to the effects of excess carbon dioxide and therefore do not tolerate the closed system of anesthesia as well. The administration of ether by the open drop or insufflation technic is considered to have a greater margin of safety. Pentothal sodium administered intravenously is not considered a wise choice for children under the age of 10 except in very brief selected procedures. The response of children to the drug is variable, and the result

may be respiratory depression with delayed recovery.

It must be remembered that the margin of safety in children is small; they are easily asphyxiated and require high concentrations of oxygen. Their response to trauma and blood loss in many instances is poor, and their ability to withstand long procedures is variable. If an infant is going into shock, one of the earliest signs is cold pale feet. An arm of the child should always be exposed for checking pulse, blood pressure, and color. If blood transfusion should become necessary, 50 cc. blood is considered the usual amount for replacement for an infant, and from 250 to 300 cc. for a child.

Types of Plastic Operations and Their Management

Operations on the mouth (harelip and cleft palate).—For the very small infant who is adequately restrained, a satisfactory method consists of induction of anesthesia with open drop ether on a mask and maintenance with ether blown directly over the face, air or oxygen being bubbled over ether and delivered through a suction tip or catheter held over the face This method requires a strong ether vapor as a great deal of the vapor is wasted.

For older children a more satisfactory technic consists of the insufflation of ether into the nasopharynx by means of a 12 or 14 F. catheter inserted into the nose. The catheter should be sterile and lubricated. The distance from the tragus of the ear to the ala of the nose is the desired length for insertion. One should make certain that the tip of the catheter does not extend into the trachea or esophagus. The patient should be in a slight Trendelenburg position in order to facilitate drainage of blood and mucus and to make working conditions better for the surgeon. This technic requires the presence of a trained assistant to maintain the airway by traction on the tongue with a suture, or otherwise, and to suction constantly with a sterile suction tip.

The disadvantages of the insufflation technic are:

1. The airway is often maintained with difficulty by the surgeon or assistant and is beyond the control of the anesthetist. Partial obstruction frequently exists and results in congestion of the venous system and increased oozing.

2. Anesthesia is more difficult to maintain at a constant level. The quantity of ether vapor delivered is frequently insufficient to maintain anesthesia for adults. Leaks or mechanical defects may decrease the output of ether vapor even though the apparatus appears to function well. Vaporization varies as the temperature of ether changes.

3. The catheter may become plugged with blood or mucus.

For children over 6 years of age and for adults, a more satisfactory method is the intratracheal (orotracheal or nasotracheal) technic. This method reduces the risk to the patient and improves the working conditions. The airway is under control, and the danger of aspiration of blood is negligible. This technic facilitates the aspiration of blood and mucus from the respiratory tract in the event that the patient is "very wet" and prevents or re-

lieves laryngospasm. For the repair of harelip, the tube should be placed in the center of the mouth without traction in order to prevent distortion of the mouth; for greater ease the nasotracheal route should be used. It is desirable that the patient regain his cough reflex early after the operation is completed in the event of continued oozing of blood. One disadvantage of the intratracheal technic is that a deeper plane of anesthesia is necessary to depress the cough reflex. Another disadvantage is the ever present danger of trauma to the pharynx or trachea with resultant pharyngitis or tracheitis.

Operations on the nose (rhinoplasty, etc.).—If a general anesthetic is to be used for rhinoplasty, the method of choice is the orotracheal technic. This procedure is frequently facilitated by thorough cocainization of the pharynx before anesthesia is induced, particularly if the anesthesia is to be maintained by pentothal sodium given intravenously. Either cyclopropane or pentothal sodium produces a rapid induction of anesthesia. After insertion of the orotracheal tube, the pharynx should be carefully packed with wet gauze to prevent aspiration of blood and insure a tightly closed system. Maintenance of anesthesia with cyclopropane is considered preferable to the use of nitrous oxide and pentothal sodium, because the recovery time is shorter with the use of cyclopropane. It is desirable that the patient react immediately at the completion of the operation so that a thorough treacheal toilet may be carried out through the intratracheal tube with a catheter and extubation done. Because nasal packing and a pressure dressing are required, it is necessary that no obstruction exist in the mouth, hence the advantage of a quick recovery.

Operations on the ear (otoplasty).—Intratracheal anesthesia is not essential to this type of operation, and local anesthesia is to be preferred. However, if the patient demands to be put to sleep, intratracheal anesthesia frequently facilitates the procedure for both anesthetist and surgeon, particularly if the operation is bilateral and somewhat lengthy. The position of the head may interfere with the airway, and laryngospasm may be troublesome. If ether or cyclopropane administered by the intratracheal technic is not selected as the anesthetic, pentothal sodium given intravenously, supplemented with nitrous oxide and oxygen insufflation through an oral airway and local anesthesia with novocain, is often satisfactory. This method has several disadvantages:

1. Laryngospasm is prone to occur during light pentothal sodium anesthesia because the laryngeal and pharyngeal reflexes are not abolished.
2. Anesthesia of the skin is poor unless supplemented with novocain, and the patient may move even when anesthesia is at plane 1 or 2.
3. Large doses of pentothal sodium may be required to keep the patient from moving over a long period.
4. When anesthesia is initiated with this technic, it is difficult to change over to another agent after the operation has begun, and hence there is danger of overdosage and a prolonged recovery period.

Operations on the eye (ptosis, etc.).—As a rule, this type of operation can be performed with the use of pentothal sodium given intravenously, supplemented with nitrous oxide and oxygen by insufflation. In some instances, for example, if the patient is extremely obese, the intratracheal technic may be preferred.

Fractures of the mandible (circumferential wiring, or Roger-Anderson fixation).—This procedure calls for an operative field comprising the entire oral cavity, muscular relaxation of the jaw, and the privilege of moving the head at will and making traction on the mandible. The technic of Rovenstine and Hershey has been used satisfactorily in over 350 cases: After preliminary cocainization of the pharynx, blind nasotracheal intubation is performed on the conscious patient; then anesthesia is quickly induced with pentothal sodium supplemented with cyclopropane. Direct laryngoscopy is undesirable for the patient with a fractured mandible because of possibility of manipulation of the bony fragments.

A unilateral or bilateral mandibular nerve block may be used in selected cases, although most patients experience some discomfort.

Aspiration of vomitus and suffocation resulting from postoperative vomiting, even after the return of pharyngeal reflexes, are real hazards. A properly instructed nurse should remain with the patient so that the wires or rubber bands may be loosened in those instances in which the jaws are wired together.

Mandibular resections (prognathism and ankylosis).—These cases may be handled as are cases of fractured mandible, although it is preferable to have the patient unconscious for intubation. Mandibular resections are time consuming and are often attended by considerable blood loss. Fluid replacement with glucose solution or whole blood is usually indicated.

Reconstructive maxillofacial operations.—The anesthetic problems peculiar to oral and facial operations have received considerable attention recently because of the tremendous increase in reconstructive operations as a result of war injuries. Thornton and Rowbotham[2] reported a series of cases in which the patients were treated in the acute stage of their injuries, while Papper and Rovenstine[3] discussed the management of anesthesia for the repair of maxillofacial injuries in the late stage.

Regional anesthesia is usually inadequate for prolonged reconstructive surgery. For injuries less than twenty-four hours old, the most satisfactory method of anesthesia consists of cocainization, induction with pentothal sodium, insertion of a nasotracheal airway, and maintenance with ether or cyclopropane or pentothal sodium with nitrous oxide and oxygen. In the presence of edema of the face and neck and intraoral bleeding, a preliminary tracheotomy is advisable to provide an airway and for the administration of inhalation anesthetics. Where there is no danger of obstruction of the airway, regional anesthesia plus the ad-

2. Thornton, H. L., and Rowbotham, S.: Anesthesia in maxillofacial surgical unit with the British Liberation Army. Anesthesiology **6**:580-596, Nov. 1945.

3. Papper, E. M., and Rovenstine, E. A.: Anesthetic management in reconstructive surgery of the mandible. Am. J. Orthodontics **32**:433-438, July, 1946.

ministration of pentothal sodium intravenously and oxygen may prove satisfactory.

Operations on the extremities (deformities, contractures, skin grafts).—When the surgeon is not operating in the region of the head and neck and is not encroaching on the air passages, anesthesia for plastic operations differs little from that for other types of surgery. The face mask may be applied and any agent used unless otherwise contraindicated.

Minor operations (removal of moles, scars, cysts, tumors, etc.).—Many minor operations may be performed with the patient under local, infiltration, or regional anesthesia with the use of novocain, 1 to 2 per cent, and adrenalin. The decision to use this type of anesthesia is usually reached by the patient and the surgeon. There is no need for a patient to undergo a general anesthetic when the operation can be performed painlessly and successfully under local anesthesia. Anesthetic accidents and fatalities have been known to occur even when the operation has been very minor.

COMPLICATIONS

Anesthetic complications vary with the experience of the anesthetist, the co-operation between the surgeon and the anesthetist, and the co-operation among the members of the surgical team as a whole. Complications due to faulty equipment are inexcusable. Some of the complications may be due to the following factors:

1. Abnormal mucus secretion.
2. Oversedation resulting in respiratory depression.
3. Obstruction of airway with asphyxia from mucus or blood, overdosage of anesthetic, laryngospasm, kinking of intratracheal tube, mucus in the intratracheal tube, aspiration of vomitus.
4. Circulatory shock from hemorrhage or trauma.
5. Emergent delirium or excitement. This may be controlled by the slow intravenous injection of morphine or apomorphine, 1 to 2 mg. in 10 cc. of saline.
6. Cocaine reaction with convulsions may be controlled by injection of pentothal sodium intravenously and artificial respiration with an adequate airway.
7. Nausea and vomiting may be excessive. It is more likely to follow a stormy anesthesia or to be present when sensitivity to morphine exists. Gentle handling and avoidance of sudden changes in position are recommended.

The anesthetist should accompany the patient to his room and remain with him until his condition is considered satisfactory. A nurse or intern should remain with the patient until he is reacting and should be familiar with the dangers of obstruction from emesis or blood or laryngospasm. The nurse should watch vital signs, respiratory exchange, pulse, and blood pressure and should notify the intern of any untoward change.

SUMMARY

The management of anesthesia for plastic surgery has been discussed with emphasis on the various types of surgery and the multiplicity of anesthetic agents and technics available. Since all of the problems of anesthesia are by no means solved, the lack of a fixed routine adds not only to the safety of the patient in that each case should be managed individually but also to the interest for the anesthetist in striving for improved methods.

I should like to acknowledge my gratitude for the very capable assistance of Dr. Katherine Byers without whom I could not have prepared this article.

FLUID BALANCE

Edgar J. Poth, M.D., Ph.D.*
Galveston, Tex.

When an individual is in fluid balance, the intake and the output of fluids are equal, and a so-called "steady state" exists. It is required not only that the water exchange be balanced but also that the salts, or electrolytes, be in a similar state.

For the purpose of orientation, let us first consider the average distribution of fluids among the large compartments of the body and the concentration of these fluids in milliequivalents. The milliequivalent is defined in table 1. The reason this unit is used is that it permits direct comparison of the various chemical substances as illustrated in figure 1, which gives the concentration of the various ionic constituents of plasma, interstitial fluid, and intracellular fluid. Figure 2 gives the volume distribution, the flow, and the apparent equilibriums, or "steady states," encountered. These data are further amplified by the schematic representation of both normal and abnormal shifts and losses of electrolytes and water by the body (fig. 3). This figure indicates the type of fluids lost by fistulas or aspiration tubes lying at different levels in the gastrointestinal tract. Examination of the electrolyte composition of secretions at various levels of the gastrointestinal tract indicates the possible abnormalities that might develop from excessive fluid losses, that is, alkalosis resulting from excessive loss from the stomach as compared with acidosis resulting from severe diarrhea, as is evident from the data presented in figure 4.

Read before the Annual Meeting of the Texas Association of Nurse Anesthetists, Galveston, April 21, 1949.

*From the Surgical Research Laboratory, University of Texas, Medical Branch.

Disturbances of Fluid and Electrolyte Balance

All alterations of fluid balance may be classified essentially as (1) primarily of water, (2) primarily of salt, and (3) combined water and salt disturbances. These disproportions are listed in table 2 and represented schematically in figure 5. The mechanisms by which these aberrations occur will not be enumerated.

Signs and Symptoms of Dehydration

The more rapidly dehydration occurs, the more acute will be the signs and symptoms. The reactions are less severe in a young healthy adult than in an older person in poor physical condition. Likewise, the manner of development of dehydration alters the response. When depletion is due to water restriction with little salt loss, there are extreme thirst, dryness of the mouth, and oliguria with high specific gravity of the urine if kidney function is normal. Later there are disorien-

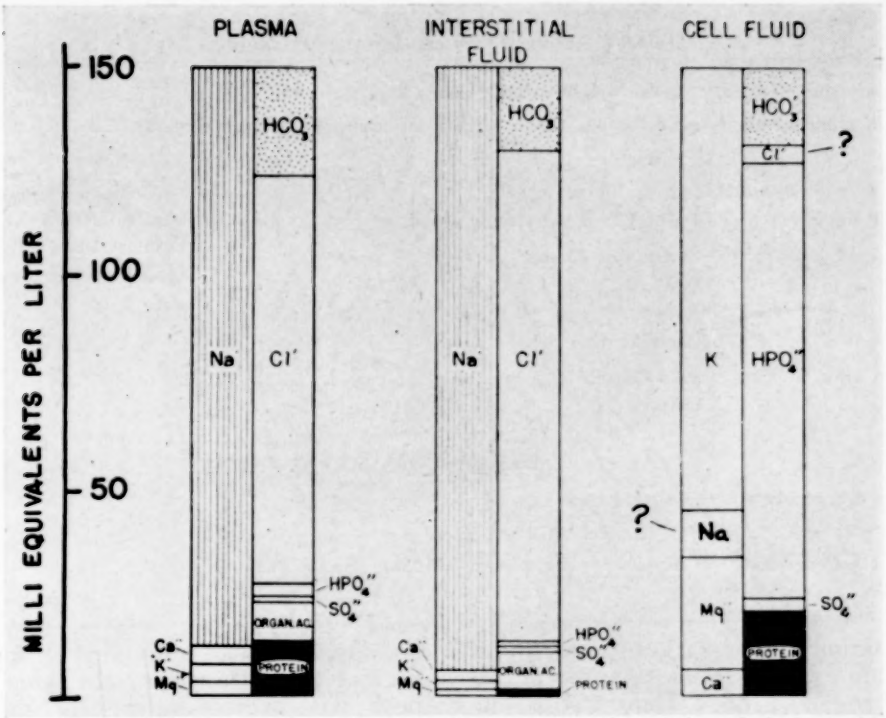

Fig. 1.—This diagram shows the approximate concentration of the principal constituents of the three fluid compartments of the body. These concentrations are given in milliequivalents; the sums of the cations and anions are given in the right and left hand columns respectively. Obviously, these two columns must be equal in a chemically balanced solution.

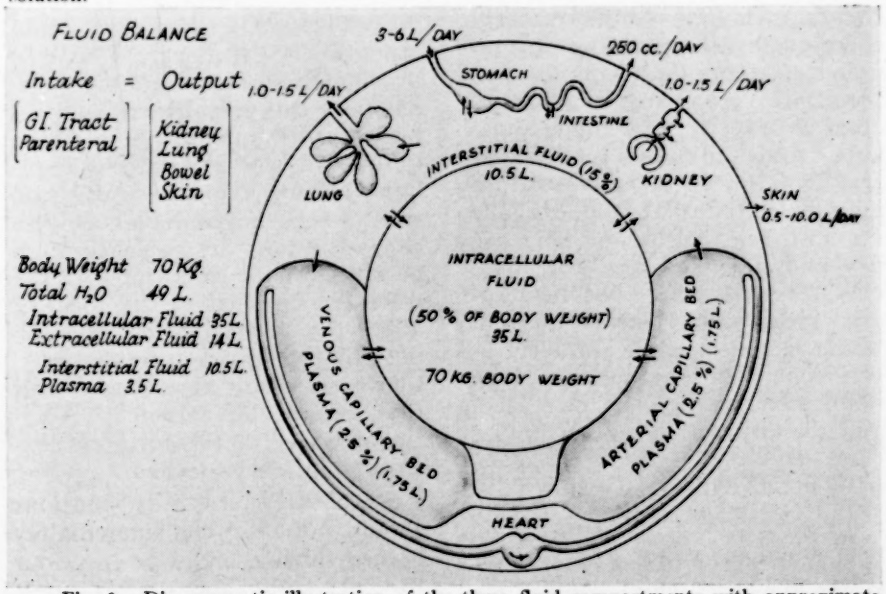

Fig. 2.—Diagrammatic illustration of the three fluid compartments with approximate pertinent data.

Table 1.—Equivalents and Milliequivalents

An equivalent (Eq.) is the weight of ionic group divided by the valence.

A milliequivalent (mEq.) is one thousandth of an equivalent.

$$NaCl \rightleftharpoons Na^{+} + Cl^{-}$$

1 Eq. of Na^{+} = 23 Gm. (23 is the atomic weight of Na)

1 mEq. of $Na^{+} = \frac{23 \text{ Gm.}}{1{,}000}$, or 23 mg.

Likewise:

1 mEq. of $Cl^{-} = \frac{35.5 \text{ Gm.}}{1{,}000}$, or 35.5 mg.

$$MgSO_4 \rightleftharpoons Mg^{++} + SO_4^{--}$$

1 Eq. of $Mg^{++} = \frac{24}{2}$, or 12 Gm.

1 Eq. of $SO_4^{--} = \frac{32 + (4 \times 16)}{2} = \frac{96}{2} = 48$ Gm.

tation, hallucination, coma, and a slow increase in nonprotein nitrogen of blood. Dehydration due to electrolyte loss primarily results in circulatory collapse, because there is an accompanying water deficit with shrinkage of the extracellular volume. Early there are apathy, weakness, somnolence, anorexia, nausea, and blood pressure changes. With increased severity, low blood pressure and circulatory collapse result. The rectal temperature may be subnormal, the eyeballs are soft, the tongue and skin are dry and wrinkled, and the muscles are putty-like. The hematocrit index and plasma protein levels increase, while the electrolyte concentrations decrease. The nonprotein nitrogen is increased, and the urinary output is low.

Fluid Balance During Anesthesia

If adequate water and electrolytes, primarily sodium chloride, are supplied to an individual with normal renal function, the kidneys will excrete selectively so as to maintain an essentially normal fluid balance, even though an extra burden has been placed upon these organs.

Unfortunately, however, renal function is frequently impaired by anesthesia for variable periods, and this impairment will interfere with maintenance of the normal physiologic state by regulation of excretion of water and salt. There might have been an excessive loss of water through perspiration or vomiting. If the water is supplied in the form of a 0.9 per cent solution of sodium chloride given intravenously, there will result an excess of salt that cannot be excreted. Additional water in the form of dextrose solution is needed.

As a safeguard, salt solutions should not be given immediately before, during, or for twenty-four to forty-eight hours after anes-

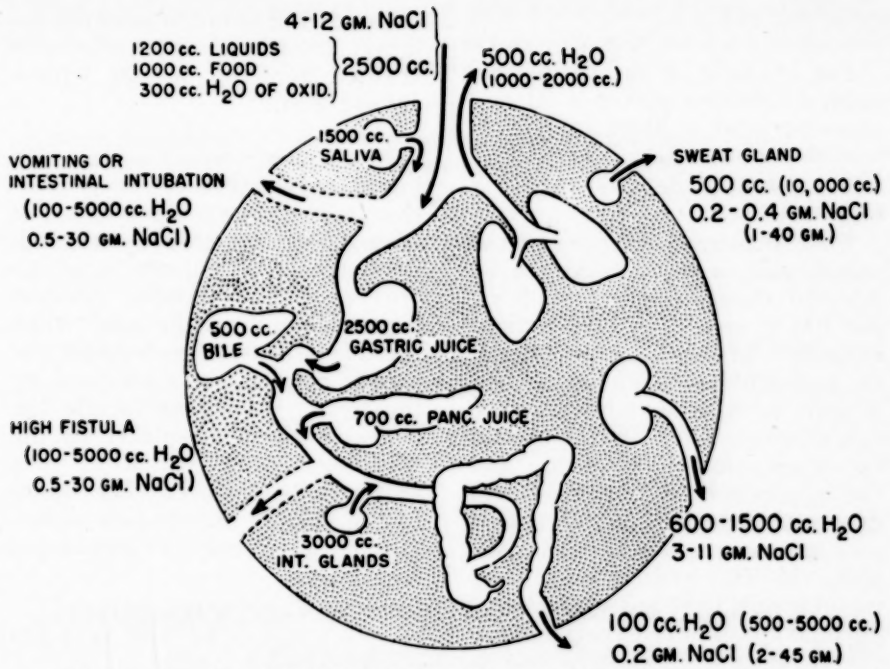

Fig. 3.—Schematic representation of the intake and output of body fluids, both normal and abnormal. There are several sources of fluid loss that are frequently overlooked. For example, saliva (1,500 cc. daily) is usually swallowed and reabsorbed. In cases of esophageal obstruction this fluid is completely lost. The insensible losses are ordinarily approximately 1,500 cc. daily each in expired air and perspiration.

thesia unless there has been an abnormally large electrolyte loss due to vomiting, gastrointestinal fistulas, or large draining wounds. In the event of loss from the gastrointestinal tract, the loss should be replaced by the appropriate solution depending upon the electrolyte pattern of the fluids lost (table 3). Ordinarily, volume for volume replacement may be practiced using equal parts of 0.9 per cent sodium chloride solution, Ringer's solution, or lactated Ringer's solution and 10 per cent glucose in water.

CORRECTION OF SEVERE DEHYDRATION

A water loss of 6 per cent of the body weight results in severe dehydration. Correction of this deficit during twenty-four hours for a person weighing 70 kg. would require:

Water for vaporization 10% glucose in water	1,500 cc.
Water for urine 10% glucose in water	1,500 cc.
Electrolyte for dehydration Equal parts of 10 per cent glucose in water and 0.9 per cent salt solution. Ringer's solution or lactated Ringer's solution as indicated.	4,200 cc.
TOTAL	7,200 cc.

If there has been vomiting with loss of acid and development of severe alkalosis, hydrochloric acid should be given in 0.9 per cent sodium chloride solution. The quantity of 36 per cent hydrochloric acid required is calculated as follows:

Cc. of 36% HCl =
(vol. % CO_2 —70) × 0.028 × wt. kg.

For example, if the carbon dioxide-combining power is 90 volumes per cent, a 70 kg. individual would require (90 —70) 0.028 × 70 = 39.2 cc. of 36 per cent hydrochloric acid.

The quantity of the concentrated acid in the solution to be injected should not exceed 5 cc. per 100 cc. of 0.9 per cent sodium chloride. Therefore, the 39.2 cc. of hydrochloric acid should be diluted to 800 cc. with isotonic salt solution. This solution should be given slowly by vein, and the injection discontinued should dyspnea appear. If the necessary laboratory data are not available, M/100 hydrochloric acid may be injected slowly until carpopedal spasm and hyperpnea are relieved. Ammonium chloride solution, 0.9 per cent, may be substituted for the M/100 hydrochloric acid.

If the dehydration is due to a lower bowel fistula or severe diarrhea, acidosis may supervene. The acidosis is corrected by the administration of sodium bicarbonate or sodium lactate. Sodium lactate should not be used when there is liver damage, because the lactate radical is metabolized by the liver. When the lactate ion is destroyed, it is replaced by the bicarbonate ion, which in turn reduces the acidosis. The quantity of sodium bicarbonate or lactate required may be calculated as follows:

mM = (60 — vol. % CO_2 content)
× 0.7 × wt. kg. ÷ 2.24

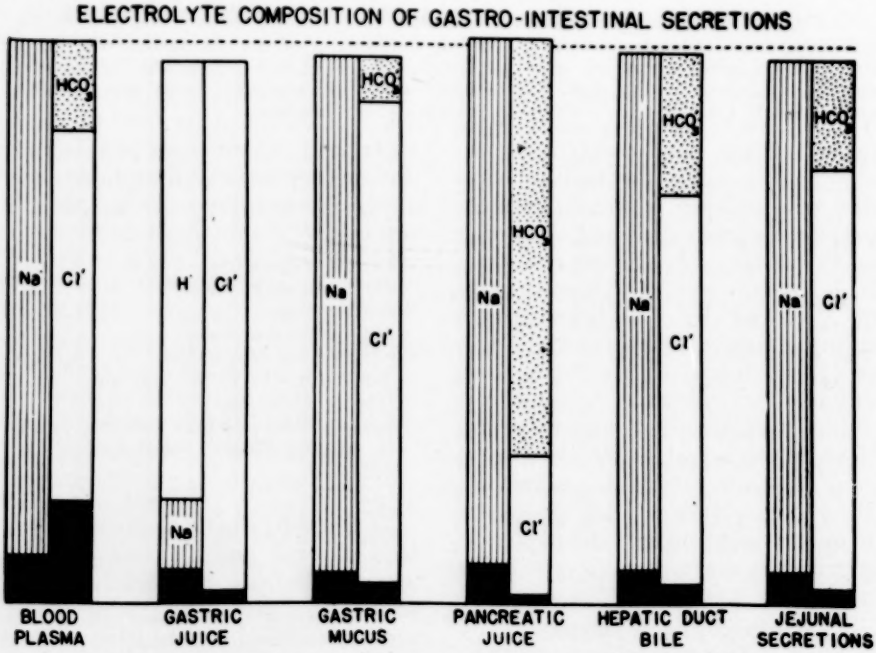

Fig. 4.—Representation of the relative equivalent composition of the various secretions into the gastrointestinal tract. The sodium ion concentration is approximately that of plasma. Loss of these digestive fluids through vomiting, aspiration, fistulas, or severe diarrhea will result in loss of the respective electrolytes in these proportions.

TABLE 2.—CLINICAL DISORDERS OF FLUID AND ELECTROLYTE BALANCE (EXTRACELLULAR)

WATER DISTURBANCE		
1. Acute water deficit	Reduced extracellular volume (concentration normal)	Increased extracellular volume (concentration normal)
2. Chronic water deficit	Reduced extracellular volume (concentration increased)	Increased salt with water loss (concentration increased)
3. Absolute water excess	Loss of salt (concentration decreased)	Regional fluid shift and collection
	Alkalosis or acidosis superimposed on any of the above	

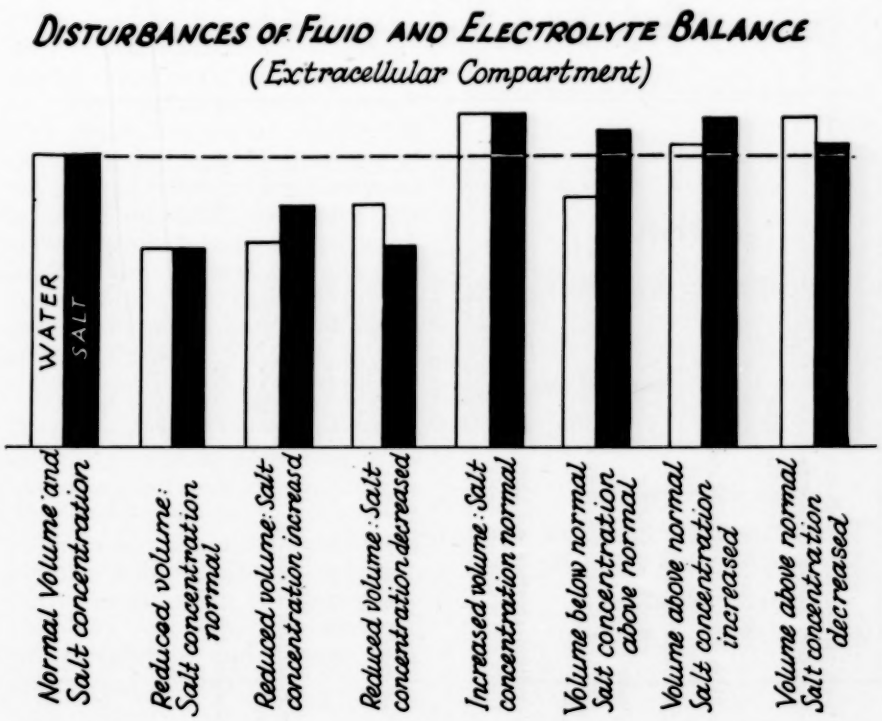
DISTURBANCES OF FLUID AND ELECTROLYTE BALANCE
(Extracellular Compartment)
WATER
SALT
Normal Volume and Salt concentration
Reduced volume: Salt concentration normal
Reduced volume: Salt concentration increasd
Reduced volume: Salt concentration decreased
Increased volume: Salt concentration normal
Volume below normal Salt concentration above normal
Volume above normal Salt concentration increased
Volume above normal Salt concentration decreased

Fig. 5.—The columns represent total water and total salt in the body fluids. The height of the water column indicates the volume of the extracellular compartment. Comparison of this column will suggest the relative concentration of fluid in the compartment.

Table 3.—Composition of Parenteral Fluids Supplying Water and Electrolytes and Comparison with Blood Plasma

Grams/Liter			Milliequivalents/Liter				
Molar sodium bicarbonate solution		84.0	Sodium	1,000	Bicarbonate	1,000	
M/100 hydrochloric acid		0.365	Hydrion	10	Chloride	10	
0.9% ammonium chloride		9.0	Ammonium	168	Chloride	168	
0.45% sodium chloride and 5% glucose	Sodium chloride Glucose	4.5 50.0	Sodium	78	Chloride	78	
Isotonic sodium chloride solution	Sodium chloride	9.0	Sodium	155	Chloride	155	
Ringer's solution	Sodium chloride Potassium chloride Calcium chloride	8.6 0.3 0.33	Sodium Potassium Calcium	148 4 6	Chloride Chloride Chloride	148 4 6	158
Lactated Ringer's solution	Sodium lactate Sodium chloride Potassium chloride Calcium chloride	2.5 6.0 0.3 0.2	Sodium Sodium Potassium Calcium	22 103 4 4	Lactate Chloride Chloride Chloride	22 103 4 4	133
Hypotonic sodium chloride solution	Sodium chloride Sodium chloride	4.5 6.0	Sodium Sodium	78 103	Chloride Chloride	78 103	
Blood plasma, mEq./L.	Sodium Potassium Calcium Magnesium	142.0 5.0 5.0 3.0	Chloride Bicarbonate Phosphates Sulfates Organic acid Protein	103 27 2 1 6 16			
	Total	155.0	Total	155			

In the absence of data needed for the foregoing calculation, M — $NaHCO_3$ plus an equal volume of 5 per cent glucose may be given intravenously until the hyperpnea and dyspnea are relieved.

POTASSIUM

Recent studies indicate that potassium is lost in excessive amounts after trauma as well as during diarrhea. It has been estimated that 50 mEq. daily may be given safely to an adult with much benefit. It must be given slowly. Renal failure and acute dehydration contraindicate its use.

SUMMARY

The proper control of fluid balance is of the greatest importance during anesthesia and in the immediate postanesthetic period. The fluid balance is frequently deranged and may assume one of several patterns, which require accurate diagnosis to assure correct treatment. Both clinical evaluation and laboratory observations should be utilized in the proper diagnosis and handling of these conditions.

Fluids for intravenous administration should be given sufficiently slowly so as not to overload the cardiovascular apparatus. These precautions become even more important in debilitated and elderly individuals. It is much better to maintain the patient on the "dry side" than to overload the circulation and tissues with water and electrolytes.

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ANESTHESIA FOR THE AGED

Samuel W. Windham, M.D.*
Dothan, Ala.

The problem of the care of the aged patient is becoming more and more important as the life span increases. By 1970, on the basis of census figures, 14 per cent of the population will be 65 years of age or older, and by 1980 we will have in this country approximately 22,000,000 people who will be 65 years of age or older. Surgery for this enlarging group requires more special considerations than surgery for younger persons, and one of these special considerations is the proper choice of, preparation for, and the administration of the best anesthetic. I do not believe that too much stress should be placed on the chronologic age of the patient, for some persons deteriorate much more rapidly than others. The physiologic age is much more important, and it is governed by both intrinsic and extrinsic factors. Congenital defects, specific toxins, and metabolic or neoplastic changes may result in premature physiologic old age, as can systemic disease; excessive smoking, eating, and the drinking of alcoholic beverages; and exposure to toxic industrial agents. Therefore, every aged patient becomes a special problem and must be evaluated as such before the proper choice of preoperative preparation, anesthesia, and postoperative care can be made.

The mortality rate in surgery of the aged has been reduced to such a favorable figure that no patient, regardless of age, should be denied surgery simply because of his chronologic age. Emergency operations in the aged still carry a high mortality rate, but if the principles discussed in this presentation are followed, this figure can be favorably reduced. It is not my purpose to discuss the technical details of the administration of anesthetics but to discuss the preparation of the patient for anesthesia, the choice of the anesthetic, and the care during the immediate postoperative period.

Preoperative Preparation

An elderly patient is usually accustomed to certain habits and surroundings, and changes in these are major factors to him. I therefore highly recommend that an elderly patient who is to have an elective operation should be hospitalized forty-eight to seventy-two hours prior to the time he is to have the operation. During this period he can become accustomed to his new surroundings and come to respect the professional staff of the institution in which he is hospitalized. I do not think that he should be too strictly disciplined, nor should radical changes be made in his

Read before the Southeastern Assembly of Nurse Anesthetists, Biloxi, Miss., April 28, 1949.
*Frasier-Ellis Hospital.

normal habits. During this observation period he should be encouraged to believe that the operation will be successful and that he not only will survive the operation but will have a relatively uneventful postoperative recovery. During this period he should have a complete physical examination with special reference to cardiac, respiratory, and kidney reserves. Routine laboratory work, including blood studies and urinalysis, should be done, for many of these patients will be found to have diabetes mellitus, anemia, or other chronic diseases. According to a reported large series of surgical operations in the aged, approximately 25 per cent of the patients will be operated on because of malignant disease. It is now well known that routine blood studies do not indicate the exact condition of the blood, especially of patients with malignant disease. It is therefore important to make blood volume and hematocrit studies in order that the blood can be made essentially normal before the operation. In addition to mental relaxation, physical rest should be encouraged. I think that it is important that the patient's mental attitude toward the operation be improved, for an elderly patient easily loses his appetite and decreases his fluid intake if mentally depressed. Foods and fluids should be forced during the preoperative period providing there are no contraindications. Specific stress should be placed on the protein intake, and all such patients should receive concentrated vitamin supplements, especially vitamin B complex.

Preoperative medication for the aged patient is extremely important. It should be remembered that barbiturates are poorly tolerated and produce excessive depression. The philosophy of life of the elderly person is different from that of the young or middle aged person. He is much less apprehensive. For this reason, barbiturate sedation is rarely necessary and should be omitted. The effects of morphine on these patients are unpredictable. It frequently produces depression out of proportion to the expected effect. It may produce hypotension and alterations in respiration manifested by either Cheyne-Stokes respiration or significant decreases in rate and depth of breathing. With a decrease in blood pressure and respiratory changes, anoxia occurs, and psychic changes that may progress to coma may occur. As is true of the barbiturates, it is well, when possible, to avoid using morphine in the preoperative medication for these patients. The belladonna drugs, including atropine and scopolamine hydrochloride, tend to decrease the depressing effect of morphine and the barbiturates and should be used when either of these drugs is used. In addition, the belladonna drugs inhibit secretions and, in so doing, tend to prevent aspiration phenomena. I consider demerol the most satisfactory preoperative drug for these patients because of its bronchodilating effect and the smaller amount of mental depression associated with its use. I prefer to give no preoperative medication to an aged patient, but if it is given, it should be used in the smallest possible doses compatible with the pain and apprehension of the patient. It is much better to supplement

the medication by intravenous administration on the operating table than to operate on a patient who is overly medicated.

I strongly recommend that every elderly patient have gastric aspiration and gavage prior to operation. A recent fatality on the operating table occurred because the patient had massive aspiration after vomiting on the table. Every aged patient should go to the operating table with an empty stomach.

Choice of Anesthetic

The actual choice of the anesthetic agent is extremely difficult. The type of anesthesia used should permit the patient to get out of bed at the earliest possible time. It should interfere as little as possible with the already failing organism and contribute everything possible to the patient's comfort and peace of mind. In addition, anoxia is poorly tolerated by the aged patient, and the anesthetic agent should produce a minimum of anoxia. Blood pressure changes should be minimized, for either marked elevation or depression favors vascular accidents and vascular thrombosis. The aged patient also tolerates shock poorly, and this factor must be considered in choosing the type of anesthesia. There is no one agent that will meet these requirements. It should also be remembered that fifteen minutes of inhalation anesthesia in plane 3 is as detrimental as two hours of the same type of anesthesia in plane 1.

I shall now briefly mention some of the factors in the choice of the individual anesthetic agents. The time-honored method of open drop ether is losing favor. However, it continues to be the most frequently used general anesthetic in this age group. I believe the reason is that the anesthetist realizes he faces a difficult situation, and if ether is given and complications arise, he can feel that he picked the best known and easiest administered agent. The occurrence of liver damage, acidosis, and postoperative vomiting after ether anesthesia is well known. All of these effects are poorly tolerated by the aged patient. For this reason there are several anesthetic agents that are preferable to ether in any form in which it might be administered. With the use of nitrous oxide, a low oxygen concentration must be maintained to produce anesthesia. Also the ability of nitrous oxide to produce relaxation is poor. Without supplementary anesthesia, I consider it a poor choice. Ethylene, because of its explosive nature and its tendency to produce anoxia when used alone, is also a relatively poor anesthetic. I consider cyclopropane the anesthetic gas of choice, although I realize that it must be used with caution in a patient with cardiac disease and know that it produces cardiac irregularities. Atropine in the preoperative medication decreases the arrhythmias produced by this anesthetic gas. Its great advantages are the ease and speed of induction and the high oxygen concentration that may be used in its administration. This anesthetic gas in combination with curare is, to me, the preferred general anesthetic for elderly patients.

If general inhalation anesthesia is chosen, I prefer to have the

agent administered by the intratracheal method, because of the difficulty in fitting masks to the faces of these elderly persons, who, in most instances, are edentulous and have irregular facial contours. The intratracheal method maintains an absolutely patent airway, and the bronchial tree can be aspirated at any time during and immediately after the operation. It also produces tracheal obstruction in relation to the esophagus and thereby prevents the aspiration of vomitus. I strongly recommend this method of administration.

The effect of avertin is too depressing, and it is contraindicated in the patient with diminished cardiac reserve, liver disease, or chronic pulmonary disease and in the patient who is in or has recently been in shock. This agent has no place in my armamentarium of anesthetics for elderly patients.

Local infiltration of novocain provides satisfactory anesthesia. However, there is a percentage of elderly patients who have definite reactions to this agent. Consequently, every aged patient should receive a test dose before the agent is used for massive infiltration. Its successful administration also depends on the technical ability of the operator, and in most instances, because of lack of experience, the procedure is poorly performed. In general, except for minor procedures, local anesthesia is usually followed by unsatisfactory results.

Pentothal sodium given intravenously is gaining rapidly in favor and provides a satisfactory anesthesia. The induction is rapid and pleasant, and there is no postoperative nausea or vomiting. For shorter procedures in which relaxation is not expected or is produced by supplementary anesthetic agents such as curare, pentothal sodium is an almost ideal anesthetic. It does produce respiratory depression and is toxic in large doses. It should be administered in 2½ per cent solution, and the induction should be slow because of the respiratory depression produced by the anesthetic solution. If it is given in large amounts, postoperative sleep is long and undesirable. I believe that when doses of over 2 Gm. are necessary for elderly patients, pentothal sodium should be discontinued and another agent used, the combined agents being supplemented with curare for relaxation. It is very good when used in combination with 50 per cent nitrous oxide and 50 per cent oxygen. When these effects and limitations are realized, pentothal sodium provides an excellent anesthesia.

I have had no experience with refrigeration anesthesia but recognize the advantages as stated in the literature.

Spinal anesthesia is the most frequently used single type of anesthesia. It is ideal for operations on the lower extremities, lower abdomen, and prostate. In operations on the upper abdomen, it, in combination with other anesthetic agents, is excellent. An attempt is always made to keep the level of anesthesia below the eighth dorsal vertebra, but even at this level fairly good relaxation of the upper abdomen is obtained. Novocain is the least toxic of all spinal anesthetic agents and is used most frequently, with the knowledge that the duration of anesthesia will

be only forty-five to sixty minutes. The usual dose for short operative procedures is 150 mg. Metycaine, pontocaine, and nupercaine, in that order, produce anesthesia lasting up to three hours. The toxicity of the drug also increases as the length of the anesthesia increases. When prolonged anesthesia is desired, continuous spinal anesthesia, following the Lemmon technic, is commonly used. This insures prolonged anesthesia by frequent repetition of small doses of the anesthetic agent during the operative procedure. It also makes possible the use of the less toxic anesthetic agent novocain. I consider this the anesthetic agent of choice for elderly patients, providing, of course, there are no contraindications to its use.

Because of the decrease in blood pressure that frequently accompanies spinal anesthesia, ephedrine or neosynephrin is always used in conjunction with the anesthetic. Some of the newer agents have been tried, but none has been more satisfactory than the two named. The doses of these drugs are varied as necessary. I believe that it is very important that these agents be given intravenously to an elderly patient who has hypotension secondary to spinal anesthesia, because the absorption from the subcutaneous tissue is poor, and the effect of the drug is frequently not obtained until the blood pressure has returned to normal, and at that time a dangerously high blood pressure may be produced. Doses of 25 mg. ephedrine hydrochloride given intravenously are satisfactory.

There are certain contraindications to spinal anesthesia. These are: patients with diseases of the central nervous system, marked hypertension or nephritis in which a decrease in blood pressure might result in acute renal insufficiency; patients who have a pronounced decrease in blood pressure after the administration of the preoperative medication; and patients in or just recovering from shock. It is also used with caution in patients with severe anemia.

Spinal anesthesia has not been used for thoracic procedures or any other procedure above the diaphragm. In upper abdominal surgery, when it is supplemented by small doses of pentothal sodium and enough curare to produce satisfactory relaxation and given in fractional doses as continuous spinal anesthesia, I consider it the nearest to ideal anesthesia for patients in this age group.

Curare, in its purified form, is a valuable adjunct to any type of anesthesia. Its only toxic effect is respiratory paralysis, and, as long as the airway is patent and oxygen is available, there are apparently no serious ill effects. It is frequently used in conjunction with inhalation and intravenous anesthesia.

The prevention and treatment of shock in these patients is extremely important, as they do not tolerate it at all well. Fluids are always given intravenously. I firmly believe that there should be no such thing as postoperative transfusion. Transfusions should be given during the operation as the blood loss occurs. A word of warning as to the use of colloid solutions during operations: It is now well known that sodium chloride is poorly tolerated by surgical patients in the immediate

postoperative period. Therefore, it should not be given during or immediately after operation. Also a word of warning as to the quantity of fluid used: It is better that the patient stay relatively dry during at least the first seventy-two hours after operation. For this reason, large quantities of fluid given on the operating table may be definitely detrimental. Blood volume should be maintained by blood transfusions and not by colloidal solutions, such as glucose in saline or glucose in water.

POSTOPERATIVE CARE

The immediate postoperative period for these patients is usually closely followed by the anesthetist and is extremely important in determining the outcome of the surgical procedure. Anoxia should be prevented by the free use of oxygen. The airway must be kept patent. To accomplish this, frequent aspirations or even bronchoscopy and aspiration may become necessary. The patient should be encouraged to move about in bed and never maintain one position for any long period. Early ambulation, I believe, is a marked advance in the postoperative care of these patients. The fluid balance must be maintained; however, the choice of the type and quantity of fluids used should be made as suggested previously.

SUMMARY

With a careful physical evaluation of the patient and preoperative preparation, the wise use of preoperative medication, and the proper choice and administration of the anesthetic agent, age is not too great a surgical hazard. Shock and anoxia must be prevented and the proper fluid balance maintained. Through the proper care of the patient, the judicious use of the many anesthetic agents now available, and the performance of meticulous surgery, the mortality rate in geriatric surgery should continue to decline.

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HAZARDS OF COMBUSTIBLE ANESTHESIA

Glenn Rowell, Engineer*
Minneapolis

The subject "Hazards of Combustible Anesthesia" can be discussed rather freely now, as most surgeons recognize the value of accident prevention, even when applied to their field. Fortunately, much of the opposition that existed ten years ago has disappeared, and today even the manufacturers of hospital equipment are constructing apparatus safe for use with gaseous anesthetics.

Some ten years ago the National Fire Protection Association asked Dr. J. Warren Horton, professor of biological engineering, Massachusetts Institute of Technology, to form a committee to prepare a national standard covering the use of combustible anesthetics. Dr. Horton selected to serve on the committee a number of capable individuals, among them Dr. Carter of the American Medical Association, Dr. MacEachern of the American College of Surgeons, Dr. E. A. Rovenstine, Dr. Morrill of the American Hospital Association, and several others. After several years of experiment and study, this committee prepared a set of standards governing the construction of, the type of equipment best suited for, and the necessary safeguards for, the operating room in which combustible anesthetics might be used. Of the twelve men on the committee, only one failed to approve all of the new standards. Copies of those standards may be obtained from the National Fire Protection Association, 60 Batterymarch St., Boston 10, Massachusetts, for twenty-five cents per copy. The text of this article is based on that publication and on evidence from the investigation and experiments made by this committee and others interested in this program.

To the average person, the hospital is a haven where his ills will be cured, and he assumes that every safeguard is being provided for his well-being while confined to bed in a more or less helpless state. That is as it should be, since a person requiring hospital treatment should not have his condition aggravated by other cares or worries. But as an indication of the magnitude of the job still to be done, no hospital in this area has as yet made use of all known safeguards.

Fire records indicate that over the past decade fires in hospitals and sanatoriums have averaged more than one a day in this country alone. It might be argued that the majority of these fires occur in old buildings of inferior construction and that very few are caused by combustible anesthetics. That is true. The number of fires of any size in modern fire-resistive hospitals is very small, and, as far as I have been able to determine, no serious fire loss has resulted from the combustion of gaseous anesthetics. Nevertheless, the modern hospital contains an imposing array of hazardous materials that must

Read before the Upper Mid-West Assembly of Nurse Anesthetists, Minneapolis, May 27, 1949.

*Fire Underwriters Inspection Bureau.

be used by persons well acquainted with the safest known ways of using them if accidents are to be prevented. I contend, and I believe you will agree, that a hospital staff is responsible for the safety of the patients.

The fact that explosions of gaseous anesthetics do occur has become public knowledge. However, very few outside the profession fully appreciate the conditions that have existed, and in fact still do exist, in many hospitals. The danger of explosion of combustible gaseous anesthetics when mixed with air or with oxygen and nitrous oxide has been known since ether was first administered by inhalation. Yet there are still situations in which nothing has been done to lessen the danger. Also, all too often, members of operating room staffs labor under a false sense of security, because some small preventive measure has been taken. Anesthetics such as cyclopropane, ethylene, ethyl chloride, and ether cannot be used safely even though every known precaution is taken. All we can do is to lessen the likelihood of occurrence of an explosion by making use of as many safeguards as is possible and practicable.

The majority of explosions are caused by the discharge of static electricity, the use of the cautery, and the use of improper electrical equipment. Static electricity is without question the principal cause and also the most difficult to control. We know we can prevent the formation of static electricity by raising the humidity within a room to 60 per cent. That is not too difficult during the winter months, but during warm weather a room with a relative humidity of 60 per cent would be unbearable unless it could be artificially cooled, and that is impracticable for most hospitals owing to the expense involved. Hence we must do the next best thing and eliminate insofar as possible the generators of static electricity.

Possibly you have heard persons scoff at the very idea that static is generated during warm weather. While I will agree that it is more difficult than during cold weather, it is far from the impossible as experience has proved on many occasions After a comparatively recent accident, a sling test indicated the relative humidity in the room was only 30 per cent even though it was raining outside and had been for several hours preceding the ignition of the gases. Experiments indicate that, when the relative humidity passes 45 per cent, it does become difficult to generate and condense sufficient static to form an igniting spark, and that, when the humidity reaches 60 per cent, it is impossible.

GENERATORS OF STATIC ELECTRICITY

Static currents are generated in many ways. However, the principal hazards are woolen blankets, nurses' silk, nylon or rayon clothing, old rubber tubing and rebreathing equipment, and the patient's hair. The hazard inherent in the use of woolen blankets is best eliminated by using only cotton blankets for treatment of shock. If for some reason wool blankets must be used, they can be made fairly safe by dampening them in a humidified warming cabinet or by sprinkling them before warming. However, such measures are questionable, and

the best procedure is immediately to replace all woolen blankets with cotton in any operating room where gases are used. There are plenty of other uses for woolen blankets, so nothing need be wasted. If you have some doubt concerning the hazard of a woolen blanket, you might try unfolding one in a dark room sometime. If the air in the room is comparitively dry, you will be amazed at the electrical display.

Nurses' clothing presents a much more difficult problem, especially since the nylon uniform has been made available. A nurse walking about becomes a static generator, and if she has insulated her body with garments made of nylon, silk, rayon, or any of the other new synthetic fabrics, her body acts as an electrical condenser and stores up charges of static electricity in dangerous amounts. There are many instances in which the instrument nurse, especially, provided the spark that caused the ignition of the gases. This hazard can be eliminated only if proper clothing and shoes are worn. All garments must be made of cotton or linen, and this includes the hose. Shoes should have conductive soles.

The older type of anesthesia equipment employing ordinary rubber tubing is dangerous, but fortunately this hazard has been practically eliminated by the development of conductive rubber; machines equipped with conductive rubber tubes will dissipate the static as fast as it is generated. Tests conducted on the older type rubber tubes indicated that it was possible to build up charges of 3,900 volts, which is sufficient to throw a spark of about 1/8 inch in length. Such a current is generated by the friction of the patient's breath against the inner surface of the tubing. Therefore it is worth while to make sure that all the anesthesia equipment is provided with conductive rubber tubing. If you must continue to use nonconductive tubing, keep the face mask dampened. The rebreathing bag should never be jerked off; the anesthetist should have a firm grip on both the bag and the tubing to form an electrical path through his body for approximately a half minute. Care must also be exercised when the anesthetist removes the face mask to assure the same type of electrical path through his body as between the patient's head and the mask.

Hair when combed or stroked is also a good generator of static. Hence the patient's hair must be covered. Many hospitals are now using a linen cloth applied turban fashion. Cases on record indicate that this type of accident occurs outside the operating room after anesthesia. Therefore the covering for the hair should be left in place until the patient's lungs have been cleared of the gases. The speed at which this will occur depends entirely on the patient; as yet, no definite interval has been established as far as I have been able to determine. There have been instances where an inflammable mixture has remained in the patient's lungs for over half an hour.

To provide for adequate dissipation of static, the conductive equipment within the operating room must be tied together, and the floor should have a conductive surface. Equipment and floor should be grounded through what is known as a high re-

sistance ground to lessen the likelihood of a spark's jumping from one object to another. Doors leading to operating rooms should be equipped with grounding plates so that anyone entering will give up whatever current he may be carrying on his body.

If the hospital is one of the fortunate few that can afford the installation of humidifying equipment to prevent the accumulation of static, an automatic means of control of such units is most essential to assure that the proper amount of moisture is present at all times while gaseous anesthetics are being used. Equipment that cannot be depended upon to maintain proper conditions might be more dangerous than none.

Many of you are probably familiar with the Horton intercoupler, used in many hospitals to prevent a difference in electrical potential among the patient, the anesthetist, the assisting nurse, the surgeon, and the table. A static current-indicating device known as the "Staticator" is now available for use. This device, produced by the W. E. Anderson Company of Kansas City, Missouri, furnishes immediate evidence of the presence of a charge of static electricity on any person or piece of equipment in its vicinity.

OTHER SOURCES OF IGNITION

In addition to static as a possible source of ignition, there are a number of other possible causes, such as the cautery, roentgen ray machine, film viewer, electrical equipment and switches, sterilizers, and smoking.

The cautery cannot safely be used on any patient under gaseous anesthesia. However, its use may be justified in some instances when the possibility of infection is of greater hazard to the patient's life than the chance of an explosion within the lungs. As an example, I have been told that its use may be justified during removal of a lung. The use of surgical diathermy or roentgenography must be placed in the same class as the cautery. However, the need for either cannot be justified as easily as the need for the cautery, as they should be used preceding anesthesia.

The film viewer, electric clock, and all other equipment, if not already of the type suitable for use in a hazardous atmosphere, should be replaced with equipment that is. There are today a number of manufacturers producing hospital equipment of the proper type. It may be readily identified by the label of the Underwriters' Laboratories, which carries the following wording, "Approved for use in a Class 1, Group C atmosphere."

I am frequently asked about the use of the mercury tube switch for the control of the lights and other equipment. Many persons believe such a switch is safe to use. The switch actually has only one advantage over other switches, and that is that the snap has been eliminated making it noiseless.

Some believe that equipment located any appreciable distance above the floor is safe, since the gases used are all heavier than air and therefore will not enter the surgical lamp housing or other electrical equipment. However, experience has not justified this belief. These gases are only slightly heavier than air, and a person moving about will cause

them to bounce as a balloon filled with ordinary air will bounce. As a result there are instances in which the ignition has been caused by ordinary surgical lamps, electric clocks, and even ceiling lighting fixtures. Therefore, the present National Standards require all electrical equipment to be of the explosion-proof type unless the room is provided with an independent ventilating system that will assure at least twelve air changes per hour. If such a system is installed, the likelihood that free gases will form anywhere in the room is poor. Consequently, they cannot be bounced around, and hence the Standards state that under such conditions electrical equipment located 7 feet or more above the floor need not be of any special type. As yet there are no hospitals in this area that have such a ventilating system.

Today there are available complete lines of safe switches, receptacles, surgical lamps (produced by at least four different manufacturers), clocks, film viewers, and many motor-driven types of appliances. Thus for the hospital that wants a safe electrical installation, proper equipment is available.

Standards define the area that must be considered hazardous as any room in which the gases are stored or used and also that area extending for a horizontal distance of 10 feet and to a height of 7 feet above the floor outside of any door opening into such a room.

Of the gases used for anesthesia, cyclopropane is by far the most dangerous, as it is a ring compound and is therefore very unstable. When mixed with oxygen, as it must be, it becomes so unstable that two atmospheres of pressure will cause the mixture to explode. I mention this because of the long-established practice of exerting pressure on the rebreathing bag to sustain life should the respiration of the patient falter or stop. Such pressure exerted by either the hands or the knees can cause the mixture within the bag to explode. While the other gases are much more stable, they are not considered as suitable by many surgeons; hence the use of cyclopropane is constantly increasing.

Storage of Gases

Most hospitals do not have proper storage facilities, and all too often some closet near the operating room is used for the storage of all the gases used. Both empty and full cylinders must be treated with the utmost caution. Neither oxygen nor nitrous oxide should ever be stored in the same cabinet or room with any of the hydrocarbons. The room or cabinet used must be of incombustible construction and be vented to the outdoors. Oxygen and nitrous oxide may be stored in any portion of the building, but the other gases are preferably kept outside the building unless the cylinders are attached to the machines. Some hospitals have provided a metal cabinet on a lower roof level; others have placed a vented cabinet on brackets accessible through a window. Such precautions are necessary because of the possibility of a defective valve or fitting. The most serious explosion on record occurred at the Bellevue Hospital in New York and was caused by cyclopropane gas escaping from an empty cyl-

inder after the cylinder had been removed from the machine. In that instance the cylinder was placed beside an open window in a small storage room. The gas flowed out the window down the light well and into an open window at the bottom of the well.

OTHER HAZARDS

Safeguarding the use and storage of gases is not all that must be done, as in many hospitals there are other conditions that also must be corrected. Often the surgeons' dressing room communicates with the operating rooms, whereas there should be at least 10 feet of corridor between hazardous areas and any room in which smoking is permitted. Many persons have the erroneous idea that their sense of smell will warn them of dangerous conditions. This is not true, as persons fortunate enough to survive various types of gas explosions seldom admit they were aware that the gas was present prior to the flash.

Then there are surgeons who prefer to use head lamps. Sometime ago I visited a hospital in which the operating rooms were equipped with explosion-proof electrical receptacles, yet one of the staff surgeons had tapped dime-store cord into a heavy rubber cord attached by a proper plug so that he could use his head lamp. Head lamps using other than flashlight batteries as a current source must never be used, as they are not safe. Furthermore, their use is an admission of the need for better illumination, which might safely be had through the use of one of the four different types of approved surgical lamps available.

Matches and smoking materials must be removed from the room of any patient undergoing gaseous anesthesia.

Baby incubators, in which ordinary lamp bulbs supply the heat, are used in many hospitals, but to have one in the delivery room while some gas other than nitrous oxide is being used is unwise, as the temperature of the glass lamp bulbs is likely to be above the ignition temperature of the gas. Incubators of this type are most dangerous, even though no explosive gas is present, because lint from the bedding can gather on the heating bulbs. Then, to make matters even more serious, it is not uncommon to find oxygen being piped into an incubator whenever the tiny occupant requires it. Free oxygen with charring lint or with the grease or oil that might be present does not present a pretty picture.

SUMMARY

I trust that no reader believes that there is no need to evaluate the conditions within his hospital. Quite often I have been told that the frequency of anesthetic explosions is not more than one in fifty thousand. That may be true in some medical centers, but I know of many instances where it is quite different. Frankly, a survey of a great number of hospitals reveals many conditions that need not exist. Those of us who have been active in the work of prevention appreciate the fact that surgery is usually undertaken only when other methods are useless, and that every phase of each operation entails a certain amount of chance, but that is no excuse for anyone to take unnecessary chances.

ADEQUATE RESPIRATORY EXCHANGE

Harold L. Harris, M.D.,*
Evanston, Ill.

The introduction into clinical anesthesia of pentothal sodium and cyclopropane has greatly facilitated the induction of general anesthesia by the anesthetist. The surgeon is grateful for the speedy and profound muscular relaxation produced by *d*-tubocurarine.

Seevers and Waters,[1] when considering the desiderata of an ideal general anesthetic agent, found that the patient would prefer one that is rapid in action, with freedom from unpleasant odors and irritation, and with a recovery period free from discomfort. The surgeon would like an agent that is nonexplosive, that produces complete muscular relaxation, and that does not cause excess bleeding. The anesthetist would like an agent with a wide margin of safety and sufficiently rapid action to allow moment-to-moment control of the depth of anesthesia, and one that produces no functional or organic damage to the patient.

The ideal anesthetic agent is yet to be manufactured. Each of the various anesthetics in common use today possesses one or more of the qualities listed but lacks one or more of the others. The rapid induction of surgical anesthesia with pentothal sodium or cyclopropane is a relief to both patient and anesthetist. The ease with which the level of anesthesia may be altered, either lightened or deepened, is gratifying to the anesthetist. The rapid recovery of consciousness after the proper use of these agents is appreciated by patient, anesthetist, family, and nursing personnel. Many of the surgeon's disappointments with the degree of muscular relaxation offered have passed with the introduction of an adequate amount of *d*-tubocurarine into the patient's vein.

Thus, some of the problems of anesthetists have been solved by the introduction of not one perfect agent but of several agents, each possessing some of the desirable properties. These drugs may be used in combination to take advantage of the most desirable actions of each.

It is the purpose of this article to discuss one of the undesirable side effects held in common by the newer drugs in common usage: pentothal sodium, cyclopropane, and *d*-tubocurarine. The common disadvantage is that each is capable, by itself, of producing respiratory arrest. None is ever stimulating to respiration, and respiratory minute volume is always diminished whenever one of them is used.

One may consider respiratory exchange to be adequate when sufficient oxygen is brought to the pulmonary alveoli to maintain the arterial blood oxygenation at normal levels, and when the car-

Read before the Tri-State Assembly of Nurse Anesthetists, Chicago, May 3, 1949.

*Director of Anesthesia, St. Francis Hospital.

1. Seevers, M. H., and Waters, R. M.: Pharmacology of anesthetic gases. Physiol. Rev. **18**: 447-479, 1938.

bon dioxide tension of the venous blood is kept within its physiologic range.

The supply of oxygen and the elimination of carbon dioxide are carried on simultaneously by the same body function—respiration. Depression of pulmonary function may result in the harmful change of either anoxia or carbon dioxide accumulation, or both.

"Anoxia not only stops the machine, but wrecks the machinery." (Haldane) Even mild degrees of oxygen deficiency may cause failure of a heart in which the coronary arteries are narrowed and the blood supply to the myocardium is poor. Poor oxygenation of the tissues can further aggravate capillary dilatation due to the anesthesia, trauma, and surgical disease and set the stage for the irreversible changes of shock. Many of the delirium states seen in the immediate postoperative period can be traced to inadequate oxygen supply to the brain.

Carbon dioxide accumulation will lead to the production of respiratory acidosis. This may manifest itself in various ways. The cardiac arrhythmias encountered may, on occasion, be due, not to the anesthetic agent, but to the effects of carbon dioxide on the conduction mechanism of the heart. Even small excesses of carbon dioxide may cause the patient to hyperventilate, with subsequent exhaustion of a child, or create an elevation of blood pressure that a tired myocardium cannot support. This additional burden of work may cause the heart to fail. Dripps and Comroe[2] demonstrated that the sudden decrease in blood pressure sometimes seen after cyclopropane anesthesia is not due to the effects of the drug per se but to the sudden lowering of the blood carbon dioxide tension after the recovery from anesthesia. Cassels et al[3] showed that carbon dioxide accumulation can, by itself, create the convulsions sometimes seen with general anesthesia. Inadequate muscular relaxation may at times be due to muscles that are spastic from oxygen deficiency and carbon dioxide excess.

Knowledge of the harmful effects of diminished respiratory exchange leads us to a consideration of how we may best serve our patients. The healthy young adult will tolerate mild insufficiency of oxygen and moderate accumulation of carbon dioxide for the duration of most operative procedures and suffer little from it. However, a child with fever has great oxygen requirements, and his production of carbon dioxide is also increased. The thyrotoxic patient already has a metabolic imbalance and will poorly tolerate any interference with the oxygen supply or carbon dioxide excretion. A patient with a poor cardiac reserve or marked hypertension does not tolerate the burden of increased work against a blood pressure increased still more by carbon dioxide, or any work in the presence of diminished oxygen supply to the myocardium. If an injured patient has incurred great blood loss, he will not withstand the operative procedure and anesthesia if his peripheral vessels are dilated by anoxia or hypercarbia.

2. Dripps, R. D.: The immediate decrease in blood pressure seen at the conclusion of cyclopropane anesthesia: "cyclopropane shock." Anesthesiology **8**: 15-35, Jan. 1947.

3. Cassels, W. H.; Becker, T. J., and Seevers, M. H.: Convulsions during anesthesia; experimental analysis of role of hyperthermia and respiratory acidosis. Anesthesiology 1:56-68, July 1940.

Patients with these and other serious disease conditions appreciate the quiet and pleasant induction of pentothal sodium. The quick changes in the level of anesthesia attainable with cyclopropane are an advantage, and the surgeon may accomplish his ends much more readily if he has the advantage of a well relaxed abdomen. However, these advantages may be far outweighed by the possible sequelae of inadequate respiration if the drugs considered are used injudiciously.

We are all too prone to forget on occasion one of the admirable anesthetic properties of diethylether. The addition of this agent to the anesthetic mixture may, at times, be the solution to many problems. Ether anesthesia in the lighter planes causes, through its irritant action, an increase in respiratory exchange. It may thus be possible to anesthetize an individual adequately whose respirations are sluggish with improvement of respiratory exchange—better oxygenation and more efficient elimination of carbon dioxide.

SUMMARY

This article has brought to your attention some of the advantages and disadvantages of pentothal sodium, cyclopropane, and curare. There are others that do not admit of mention because of spatial limitations. Attention is focused on the ability of these drugs to cause inadequate respiratory exchange—the failure adequately to oxygenate the arterial blood and/or the failure adequately to eliminate carbon dioxide.

The possible sequelae of prolonged respiratory depression have been reviewed. Other factors, such as respiratory obstruction, poorly functioning soda lime, increased "dead space" in the anesthetic apparatus, and abnormal positions of the patient or pressures on the chest or diaphragm, may aggravate or create these conditions.

It is the responsibility of the anesthetist to recognize inadequacies of respiration and to correct them at once. There should be a constant awareness that a patient pink from breathing a gas mixture high in oxygen content may still fail effectively to eliminate carbon dioxide. The airway should be perfectly free from obstruction at all times. When the respiratory exchange is inadequate, owing to shallow breathing, the situation should be corrected by lightening the plane of anesthesia, by the addition of ether to the anesthetic mixture, or by manually augmenting the respiratory exchange by exerting positive pressure on the rebreathing bag during inspiration.

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THE USE OF PENTOTHAL SODIUM ANESTHESIA IN SURGERY ABOUT THE HEAD AND NECK

Olga Schweizer, M.D.*
New York City

INTRODUCTION

Although pentothal sodium has been used as the anesthetic agent in many types of surgical procedures since its introduction into clinical anesthesia, it is only within the last few years that it has become popular for operations about the head and neck. The increasing importance of intravenous anesthesia with the ultrafast acting barbiturates for this type of surgery is due largely to the introduction of intratracheal intubation as a means of securing a free airway.

Experience with several thousand cases of pentothal sodium anesthesia on the Head and Neck Service of Memorial Hospital during the past ten years is the basis for the development of the technic described in the following section and for the conclusions we have drawn concerning the advantages and disadvantages of pentothal sodium anesthesia for the type of surgery under discussion. The patients in our series varied in age from 9 to 90 years, with the majority in the later decades of life. Many of the operative procedures were of long duration (five or six hours) and produced extensive tissue damage. The following may be cited as examples of this type of operation: (1) radical neck dissection combined with resection of the mandible, floor of mouth, and tongue and (2) radical resection of the maxilla with exenteration of the orbit and curettage of the ethmoid and sphenoid sinuses. In spite of the advanced age and poor physical state of many of the patients and the extent of the operation, the results with pentothal sodium anesthesia were uniformly good throughout the entire series.

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*Director, Department of Anesthesiology, Memorial Hospital.

TECHNIC

A review of the literature of the past few years indicates that various methods of intratracheal intubation and administration of pentothal sodium are favored by anesthesiologists in different parts of the country. The technic described in the following section has been found to provide the maximum degree of safety and convenience for both patient and surgeon at Memorial Hospital.

Premedication.—Adequate premedication is essential to insure a quiet and co-operative patient and to reduce the amount of pentothal sodium necessary for induction and maintenance of anesthesia. It is important to remember, however, that the combination of large amounts of preoperative morphine and intravenous barbiturate anesthesia may lead to

prolonged periods of respiratory depression during the operation and in the immediate postoperative period. Patients scheduled for operations about the head and neck at Memorial Hospital are given morphine or demerol, atropine or scopolamine, and nembutal or sodium luminal subcutaneously or orally approximately one and a half hours prior to operation. The dosage of the drugs is determined by age and physical state. Barbiturates are administered preoperatively in an effort to avoid any untoward reactions that might result from the use of a topical anesthetic agent prior to intubation.

Intubation.—Since pentothal sodium is a cholinergic drug, the presence of mucus or blood on the vocal cords or operative manipulation in the region of the larynx and trachea can precipitate laryngospasm. This has been the major objection in the past to the use of barbiturates intravenously as anesthetic agents for surgical procedures about the head and neck. The problem is easily solved by the introduction of an intratracheal tube either before or after induction of anesthesia. In the majority of patients at Memorial Hospital the tube is inserted under topical anesthesia by the following technic. A DeVilbiss atomizer is employed to spray the pharynx, larynx, and nasal passages with a 5 per cent solution of cocaine at intervals of approximately ten minutes and five minutes before intubation. Although the "blind nasal" technic is the method of choice in the largest number of patients, it is necessary to use direct laryngoscopy in cases where the site of operation requires oral intubation or where technical difficulties make the "blind nasal" method unnecessarily difficult.

A preliminary tracheostomy under local anesthesia is performed on all patients in whom it is felt that an adequate airway cannot be maintained in the postoperative period without this precautionary measure. Such a tracheostomy would be required, for example, in a combined radical neck dissection and resection of the mandible.

The oral or nasal intratracheal tube is connected to the anesthesia machine by means of a short, firm, large bore piece of rubber tubing, equipped at one end with a metal connection for the tube and at the other with a Y-shaped catheter adaptor for attachment to the breathing tubes of the machine A special fitting, constructed from the inner tube of a tracheostomy tube of a size comparable to the one in use in the patient, is employed whenever a preliminary tracheostomy has been performed. This fitting is attached to the Y-shaped catheter adaptor by a piece of large bore, plastic tubing approximately 18 inches in length.[1] These connections make it possible to administer oxygen or a supplementary 50-50 per cent mixture of nitrous oxide and oxygen throughout the operation. They also provide a means of assisting the voluntary respirations of the patient or of giving artificial respiration should the need for such measures develop during the operation.

Conduct of anesthesia. — After intubation has been completed, venipuncture is performed in an

1. Schweizer, O.: Pentothal sodium anesthesia for operations about the head and neck. Cancer **2**:223-243, 1949.

accessible vein in the arm opposite the site of operation. The needle is connected to a 20 cc. syringe containing the 2.5 per cent solution of pentothal sodium and to the tubing of an infusion set by means of a two way stopcock. Pentothal sodium is administered by the fractional method throughout the operation. Unless contraindications exist, it is supplemented with a 50-50 per cent mixture of nitrous oxide and oxygen.

At the conclusion of the operation, the intratracheal or tracheostomy tube is utilized to carry out thorough suctioning of the tracheobronchial tree. The intratracheal tube is not taken out in the operating room but is left in place after the patient is returned to the ward until complete recovery of consciousness has occurred. Removal of the tube before this time has necessitated emergency bedside tracheostomy on one or two occasions.

MODIFICATIONS OF MEMORIAL HOSPITAL TECHNIC

The main variations of the Memorial Hospital technic, as described in the literature or by personal communication, concern the method of intubation and the strength of the pentothal sodium solution employed. Many anesthesiologists who intubate the patient after induction of pentothal sodium anesthesia use prolonged and careful preliminary application of topical anesthesia similar to that employed for bronchoscopic studies.[2] Others prefer mixtures of pentothal sodium and curare to eliminate laryngospasm and obtain muscular relaxation.[3]* Indirect rather than direct laryngoscopy for the placement of the tube has found favor in some clinics.†

The most frequent deviation from the fractional method of giving pentothal sodium is the maintenance of anesthesia with a continuous drip of dilute solution (1:1,000-1:2,000) after induction with a solution of greater strength.

There are advantages to all these technics, and in the hands of an anesthesiologist experienced in its use, each one provides efficient and safe anesthesia for operations about the head and neck.

OPERATIVE COMPLICATIONS

Although isolated instances of a variety of major and minor complications have occurred during the course of operations per-

2. Elliott, H. L., and Arrowwood, J. G.: Anesthesia for oral surgery in the presence of cautery and diathermy. Anesthesiology **6**:32-38, 1945.

3. Greif, E. W.; Richards, R. C., and Alexander, F. A. D.: Anesthesia for thoracoplasty: the use of a pentothal-curare mixture supplemented with nitrous oxide-oxygen. Anesthesiology **9**:637-643, 1948.

*NOTE:—In the months that have elapsed since this paper was delivered, intubation under pentothal sodium and *d*-tubocurarine chloride has largely supplanted the technic employing topical anesthesia alone at Memorial Hospital. After thorough cocainization, as described in the preceding section, an infusion of normal saline is started, and the patient is anesthetized with a 2.5 per cent solution of pentothal sodium. A volume of *d*-tubocurarine chloride sufficient to secure relaxation of the face muscles (usually 80-100 units) is then injected into the infusion tubing. Intubation by the nasal or oral route can be readily performed in the majority of cases within a few minutes after administration of the curare. Oxygen by face mask is started immediately after induction of anesthesia and continued until the time of intubation.

†Personal communication: Dr. Frank Keim, Newark, N. J.

formed under pentothal sodium anesthesia during the past ten years by the Head and Neck Service of Memorial Hospital, only four are of sufficiently frequent incidence to warrant further discussion. They are respiratory arrest, stimulation of the carotid sinus, tension pneumothorax, and peripheral circulatory collapse.

Apnea.—A temporary period of apnea is a frequent occurrence immediately after the induction of pentothal sodium anesthesia, especially in the patient who has had a moderately large dose of morphine as premedication. It presents no serious problem since artificial respiration can be easily instituted with the apparatus described in the preceding section.

Carotid sinus syndrome.—Operations about the head and neck often involve manipulation of the tissues around the carotid sinus. Stimulation of the sinus may lead to a reflex, mediated by the vagus nerve, that results in bradycardia and a decrease in both the systolic blood pressure and the pulse pressure. In the most severe form the blood pressure disappears, the pulse becomes imperceptible, and voluntary respirations cease. When this syndrome occurs, operative intervention in the area should be stopped until the region around the carotid sinus has been infiltrated with a 2 per cent solution of procaine. If this procedure does not restore the blood pressure and pulse rate to normal levels, an effort is made to block the vagus nerve by the intravenous injection of atropine sulfate, 1/100 to 1/75 gr. Additional therapy is usually unnecessary.

Tension pneumothorax. — One of the most serious complications of the operative period is the occurrence of a tension pneumothorax. This condition may be unilateral or bilateral. Unilateral pneumothorax is found on the operative side and the contralateral side in approximately an equal number of patients.

Although accidental surgical entry into the apex of the pleura or rupture of an emphysematous bleb accounts for a few cases of tension pneumothorax, it is our impression that a different mechanism is responsible for this complication in the majority of patients subjected to operations about the head and neck. A brief description of this mechanism follows: During the course of many operations in the lower part of the neck, fascial planes that communicate directly with the mediastinum are opened, providing a passageway for the entrance of air into this region. When this condition is associated with temporary obstruction to the airway, such as occurs during episodes of excessive coughing, air accumulates in the mediastinum under tension. The difference between the intramediastinal and the intrapleural pressure finally results in rupture of the mediastinal pleura, with development of unilateral or bilateral pneumothorax. Mediastinal air can also reach the space beneath the peripheral visceral pleura by gaining access to the lung through the hilar areas and dissecting along interstitial pathways to the periphery. Pneumothorax is then produced by rupture of the visceral pleura.

The occurrence of labored respirations, associated with decreased movement of the breathing bag in the absence of obstruction to the airway, suggests the

presence of pneumothorax in the anesthetized patient. Cyanosis and peripheral circulatory collapse may also be present. The physical signs in the chest are usually difficult to evaluate.

Unless prompt therapy is instituted, there may be serious or even fatal consequences of this condition. The first step in treatment is aspiration of the pleural space on the suspected side. If air under tension is obtained, a catheter is inserted into the pleural space through a trocar, and a system of underwater drainage is established. Failure of the patient to respond promptly to this procedure or roentgenographic evidence of contralateral pneumothorax indicates the need for underwater drainage on the opposite side also.

Shock.—Although the operative procedures performed on the Head and Neck Service of Memorial Hospital are frequently prolonged and produce considerable tissue destruction, peripheral circulatory collapse has been a rare complication. The few patients in whom signs of shock did appear responded promptly to the administration of fluids and blood.

ADVANTAGES OF PENTOTHAL SODIUM ANESTHESIA FOR HEAD AND NECK SURGERY

Pentothal sodium has so many advantages as an anesthetic agent for operations about the head and neck that at the present time it is employed in almost all cases on the Head and Neck Service of Memorial Hospital. The few exceptions will be discussed in a subsequent section.

One of the major reasons for the selection of this anesthetic agent is the fact that it can be used with safety in aged and debilitated patients, in patients with severe disease of the cardiovascular and respiratory systems, and in those with disturbances of hepatic and pancreatic function. The truth of this statement depends on two provisions: (1) the maintenance of a free airway by means of an intratracheal tube and (2) the administration of an adequate supply of oxygen at all times. Aside from an occasional temporary increase in blood sugar in a diabetic patient, no ill effects attributable to the intravenous use of the barbiturate have been observed. Since pentothal sodium is a cholinergic drug, it is necessary to take precautions to prevent bronchospasm in patients with asthma. Medication with large doses of atropine (gr. 1/75) and the administration of a bronchodilating drug such as aminophylline immediately preceding operation are part of the routine preparation of such individuals.

In addition to these general effects, pentothal sodium has several advantages from the standpoint of the surgeon. It is nonexplosive. The equipment described in a preceding section eliminates the need for cumbersome anesthesia apparatus in the operative field and allows full mobility of the head. The patient's respirations are quiet and even, and tracheobronchial secretions are reduced to a minimum.

The use of pentothal sodium has also helped to decrease the number of postoperative complications. Nausea and vomiting occurs in only a small percentage of cases, thus reducing the danger of

contamination of wounds and permitting the institution of an adequate diet shortly after operation. The general condition of the patients after pentothal sodium anesthesia is so good that the majority are given ambulatory privileges on the first postoperative day. The early restitution of physical activity, the rapid recovery of the cough reflex, and the use of chemotherapeutic agents and antibiotics combine to reduce the incidence of postoperative atelectasis and pneumonia.

Disadvantages

The major objection to the use of pentothal sodium for operations about the head and neck is an occasional prolongation of the recovery time. The incidence of delayed recovery from intravenous barbiturate anesthesia has steadily decreased as more experience has been gained with this agent. Another factor contributing to this improvement has been a reduction in the number of cases in which one or more doses of morphine were administered intravenously during the course of operation. Repeated doses of the opiates during pentothal sodium anesthesia seem to play a large part in the production of postoperative respiratory depression and delayed recovery of consciousness.

Metrazol, coramine, benzedrine, and caffeine sodium benzoate have been tried as analeptic agents at various times during the last ten years. Sodium succinate has not been used because recent reports in the literature indicate that it is relatively ineffective for this purpose.[4] It has been our experience that the only patients who seem to benefit from the analeptic agents are those in whom the plane of anesthesia at the end of the operation is so light that recovery would take place in a short time without the administration of a stimulating drug. The administration of analeptics to patients still in a deep plane of anesthesia fails to produce any marked reduction in the recovery time and in some instances may even prolong it.

The only patients in whom we believe pentothal sodium is contraindicated as an anesthetic agent for surgery about the head and neck are young children and individuals with hyperthyroidism. In addition to the difficulty and danger of intubation under topical anesthesia, the high basal metabolic rate in these two groups necessitates the use of large quantities of the barbiturate to prevent excessive movement and coughing during operation. This can lead to a prolonged postoperative recovery time with resultant atelectasis and pneumonia.

Summary

During the ten years of its use at Memorial Hospital, pentothal sodium has proved to be a safe and efficient anesthetic agent for operations about the head and neck. It can be recommended for all types of surgical procedures in these anatomic regions. The only patients in whom its use is contraindicated are young children and individuals with hyperthyroidism.

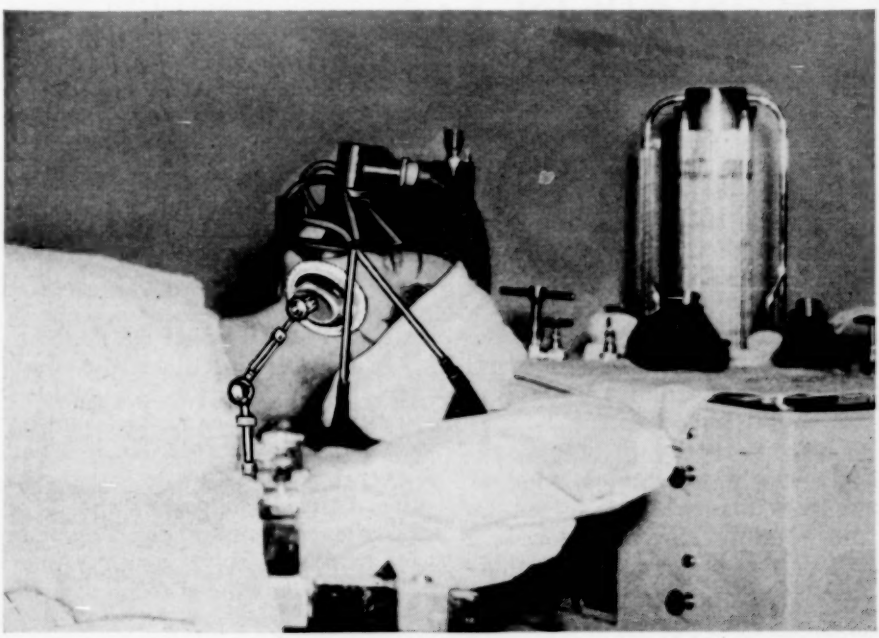
4. Tucci, J. H.; Brazier, M. A. B.; Miles, H. H. W., and Finesinger, J. E.: A study of pentothal sodium anesthesia and a critical investigation of the use of succinate as an antidote. Anesthesiology **10**:25-39, 1949.

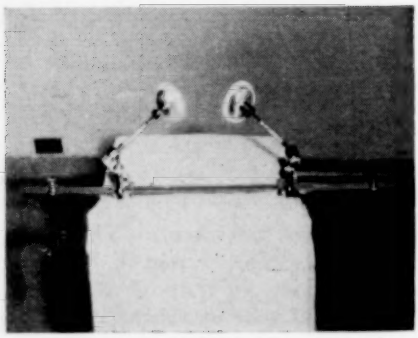
NOTES

When anesthetists get together, they talk about anesthesia. They talk about gadgets, special technics, and interesting cases. This section of NOTES was originated so that anesthetists could exchange ideas in writing as they do in conversation. Send in your contribution now. Other anesthetists will be helped by it.

Jaw-Supporting Apparatus. — The illustrated jaw-supporting apparatus was designed to support the patient's jaw at an upward angle from both sides of the patient's face, in such a manner as to give the patient a clear airway while under anesthesia and, at the same time, to relieve the anesthetist so that she may give medications intravenously, such as pentothal sodium and curare. It may also be used to advantage during operations about the head when it is essential that the anesthetist be out of the field of operation.

The apparatus consists of a bar that fastens to the sides of the operating table and passes under the patient's neck, and two adjustable attachments for holding the jaw in position. Adjustments may be made in the following manner: For the width of the face, the supports are regulated by a set screw on the bar. The angle of the jaw is main-





tained through the ball and socket adjustment and the set screw just below it. Fine adjustments may be made through the use of the ball and socket attached to the jaw piece and the sleeve between the two ball and socket joints.

Owing to the lack of standardization of operating tables, a slight adjustment will have to be made to adapt the bar to all tables.—Venus Wagner, R.N., Denver, Colo.

LEGISLATION

Emanuel Hayt, LL. B.*

Consents for Minor Surgical Procedures.—Should the patient's consent be secured for such procedures as thoracentesis (puncture of the thorax for the removal of fluid); paracentesis (puncture particularly of the wall of a cavity of the body, such as the cornea, tympanic membrane, thoracic wall); lumbar puncture (commonly known as spinal tap)?

Consent of the patient is required for all operations, whether minor or major.

Is a minor surgical procedure an operation for which authorization is necessary?

As distinguished from the practice of medicine, which includes the application and use of medicines and drugs for the purpose of curing, mitigating, or alleviating bodily disease, surgery is limited to manual operations, usually performed by surgical instruments or appliances. An operation is a surgical procedure although not always done with instruments, as in the closed reduction of a fracture. Surgical procedures are synonymous with surgical operations whether done with or without instruments. The use of an instrument to penetrate the tissues of the patient either to introduce or to withdraw a substance is a minor surgical procedure, for which the patient's consent should be obtained.

Consent may be inferred if the patient is told what is about to be done and he assents orally. The rule should be that the physician or surgeon explain to the patient the general nature of the procedure in lieu of obtaining written consent, although the latter would be preferable.

If the patient could prove no written permit was signed by him, he would be entitled only to nominal damages for a technical assault, unless he could show definite and substantial injury from the unauthorized procedure.

*Counsel for A.A.N.A.

BEWARE—IMPOSTER

A man is going about the country claiming that he is a member of the Association and presenting a membership card. He has had several loans from members of the Association on the basis of his alleged membership. This man is an imposter, and no money should be advanced to him on his representations.

THE NEWS

A.A.N.A. APPROVES RESOLUTION CONDEMNING COMPULSORY HEALTH INSURANCE

Action on House of Delegates Postponed

At the Sixteenth Annual Meeting in Cleveland, September 26-29, the delegates voted unanimously during the business session in approval of a resolution condemning federal controlled health insurance. The resolution as presented by the Public Relations Committee stated:

WHEREAS, the Board of Trustees of the American Association of Nurse Anesthetists at its meeting on September 24, 1949, passed a resolution to place the subject of federal compulsory health insurance before its membership, and

WHEREAS, such a program, although not specifically so stated in the bills heretofore proposed, must of necessity involve all branches of medical care, including anesthesia, and

WHEREAS, it is the sincere belief of this Association that such legislation will work not only against the interests of this Association but also against the best interests of the American people, and

WHEREAS, such a program would have the tendency to extend socialization in this country, be it therefore

RESOLVED that, the American Association of Nurse Anesthetists go on record as opposed to any program of compulsory federal health insurance at this time.

HOUSE OF DELEGATES

The question of whether or not the Association should institute a House of Delegates was raised after the report of the Revisions Committee. On a motion that action on the issue be postponed for two years, the majority of the delegates approved delaying consideration for further study by the members. This project is to be undertaken by the Planning Committee.

REVISIONS TO BYLAWS

The following major revisions to the *Bylaws* were approved:

That dues must be paid within ninety days after notice of eligibility for membership has been received;

That applications for inactive membership need not be renewed annually, but that a notarized statement shall be required of each applicant in which it is declared that the applicant shall notify the Executive Office immediately upon return to the practice of anesthesia, failure to comply with the ruling being cause for termination of membership without recourse to reinstatement;

That the quorum be increased to 100 Active Members representing twenty states.

MYRA VAN ARSDALE RE-ELECTED PRESIDENT

In an uncontested election, Myra Van Arsdale of Cleveland was named president of the A.A.N.A. to serve a second term. Gertrude L. Fife, also of Cleveland, was re-elected treasurer.

Officers and members of the Board of Trustees elected to serve for the 1949-50 term: (left to right standing) Julia Baines, Josephine Bunch, Gertrude Fife, Minnie Haas, Verna Bean, Mary Costello; (seated) Myra Van Arsdale, Marie N. Bader. (Not pictured: Lillian Baird and Betty E. Lank.)

Other officers to serve for the 1949-50 term are: Marie N. Bader, Colorado Springs, Colo., 1st vice president; Verna E. Bean, Lexington, Ky., 2nd vice president; Lillian Baird, Ann Arbor, Mich., Mary A. Costello, Cincinnati, and Betty E. Lank, Boston, trustees.

The new officers and trustees were introduced at a tea on the afternoon of September 27, at which members of the Ohio Association of Nurse Anesthetists were hostesses.

Award of Appreciation

At the annual banquet on September 28, Dr. Carl H. Lenhart, professor of surgery, Western Reserve University, received the A.A.N.A. Award of Appreciation in the name of the University Hospitals of Cleveland. In presenting the plaque, Myra Van Arsdale, president, said:

There are very few persons in this hall tonight to whom the name "Lakeside" does not have some sort of special meaning. To many "Lakeside" brings to mind an influence in the affairs of the Association. To some the first free association is one of recalled despair and a whispered question, "How did I ever live through it?" Others of you will think of names of people —Crile, Hodgins, Cutler, Lenhart. But whether it is a first or a final thought, the name "Lakeside" tends to have a symbolic significance in the lives of nurse anesthetists. Sooner or later to anesthetists all thoughts about Lakeside come to a focus on its school of anesthesia. And, contrariwise, any consideration of the education of nurse anesthetists and schools of anesthesia seems incomplete unless Lakeside is mentioned.

A number of factors combine to give Lakeside its symbolic significance. There are intangibles, the personalities of Dr. George Crile and Agatha Hodgins, who over the years have become almost legendary figures. There is the historical fact that Lakeside was the first formal school for the training of nurse anesthetists in this country. And there is the immeasurable influence of Lakeside graduates as directors of schools of anesthesia and as practicing anesthetists.

In many ways, Lakeside's contribution to and influence on the education of nurse anesthetists has been recognized. But this year, at this Sixteenth Annual Meeting in Cleveland, it seems proper and just that we as an association should acknowledge our debt to Lakeside and the University Hospitals of Cleveland. This evening it is my great pleasure to present the American Association of Nurse Anesthetists' Award of Appreciation to Dr. Carl H. Lenhart, professor of surgery, of the University Hospitals of Cleveland. Dr. Lenhart, to you and to the directors of the school, the surgeons, and the hospital administrators who made the University Hospitals School of Anesthesia for nurses what it is today, we extend our heartfelt thanks.

ASSEMBLY OF SCHOOLS

The Sunday session of the Assembly of Directors of Schools of Anesthesia focused attention on professional education, with emphasis on nursing education, the Association's accreditation program, and the qualifying examination for membership. The status and requirements of nursing as a profession were discussed by Sr. M. Edith, dean of St. John's College School of Nursing, Cleveland, in an analysis of *Nursing for the Future*, and Elizabeth K. Porter, professor of nursing, Frances Payne Bolton School of Nursing, in a paper on criteria for postgraduate courses in clinical nursing.

Helen Bunge, dean of the Frances Payne Bolton School of Nursing, pointed out that the university tries to provide the type of courses that the community demands and that education can be continuous and satisfying even though it is not for the purpose of obtaining a degree.

In discussing a philosophy for professional education, Joseph C. Nichols, dean of Fenn College, contended that there must be a blend of proper attitudes toward theory and practical experience. Teaching, he said, is not telling but rather inspiring the student to find out the answers for himself.

J. B. Edmonson, dean of the School of Education, University of Michigan, analyzed the purpose and methods of accreditation. While accrediting programs have done much to make the public aware of and to eliminate undesirable schools, there are dangers in too many accrediting programs, overlapping programs, and programs that inhibit the development of new educational principles and methods. Discrediting schools, he claimed, might be of more value than accrediting them.

Dr. Carl H. Lenhart (right) receiving the Award of Appreciation from President Myra Van Arsdale.

Cleveland Clinic table at the annual banquet (left to right facing camera): Mrs. Donald E. Hale, Lou Adams, Dorothy DeFrancis, Pauline Santora, Dr. Donald E. Hale, Marion Bradley; (back to camera) Virginia Schaffner and Marceil Mays.

Verna Rice, Mobile, Ala.; Leola Richter, Pittsburgh; and Margaret Giffen, Alton, Ill., at the membership tea on September 27.

(Left to right) Mrs. Garth Close, Garth Close, and Jessie Compton and Minnie Haas from Texas. For sixteen years, Mr. Close has played host at a post-banquet party for the nurse anesthetists.

GENERAL SESSIONS

Three hundred and fourteen members and students registered for the Sixteenth Annual Meeting, to make it the largest convention in the Association's history. Full attendance at the general sessions and the enthusiastic reception of the speakers indicated a genuine interest in the clinical papers, most of which will be published in the JOURNAL, as will the transcription of the forum on complex medical problems in relation to anesthesia.

At the clinics on Wednesday morning, emphasis was placed on anesthesia for thoracic and abdominal operations. The theme of the University Hospitals clinic was controlled breathing with the use of curare in thoracic operations. At the Cleveland Clinic and Cleveland City Hospital the visiting anesthetists were guests for lunch after the clinics.

INSTITUTE FOR NURSE ANESTHETISTS

An Institute for Nurse Anesthetists is scheduled for February 13 through February 17, 1950, in Chicago, with headquarters at the Hotel Stevens. The institute will be conducted by the American Hospital Association with the cooperation of the A.A.N.A.

Applications will be sent to hospital administrators about December 1. No applications will be received before that date, although anesthetists wishing to attend should begin to make arrangements with their administrators for time off during the week of the Institute.

(Seated) Sr. Gregoria, St. Vincent's Hospital, Green Bay, Wis., soon to celebrate her 80th birthday and 50 years as an anesthetist, with (standing left to right) Dr. Harold L. Harris, Evanston, Ill., Sr. Rudolpha, St. John's Hospital, Springfield, Ill., and Dr. J. S. Lundy, Rochester, Minn., at anesthesia institute in Springfield.

CONNECTICUT BECOMES 33RD STATE AFFILIATE

On September 24, 1949, the application of the Connecticut Association of Nurse Anesthetists for affiliation with the A.A.N.A. was approved. Connecticut thus became the thirty-third state association to affiliate. Officers of the new organization are Marie A. Brennan, president; Marian Magdich, vice president; Florence Kenney, treasurer; Mrs. Anna A. B. Smith, secretary.

PEOPLE AND EVENTS

Agnes M. Lange, secretary-treasurer of the Indiana association, was presented with a diamond ring by the members in appreciation of her ten years of service in that office . . . . **Mr. Charles Varney,** hospital administrator of the Milford Community Hospital, Milford, Del., recently made a contribution to the Agatha Hodgins Educational Loan Fund . . . Officers of the **Illinois** association for 1949-50 are: Pauline Henry, president; Sr. M. Borromea, 1st vice president; Mary Du Busker, 2nd vice president; Ann Priester, treasurer; Catherine Gallagher, secretary; Matilda Welinske, historian; Mary Duray, Opal M. Schram, and Mae B. Cameron, trustees . . . . The new president of the **Utah** association is Maxine Leonard of the LDS Hospital, Salt Lake City. Other officers are Mary K. Thompson, vice president, and Ina A. Christensen, secretary-treasurer . . . . More than seventy-five former students and guests registered for an anesthesia institute at **St. John's Hospital,** Springfield, Ill., on October 5 and 6 . . . . **Sr. Johanella Woityna,** Hospital Sister of the Third Order of St. Francis, sailed on March 31 aboard the S.S. President Wilson for Japan, where she has a mission appointment at St. Mary's Hospital in Himeji. She was graduated from the St. John's Hospital School of Anesthesia in Springfield, Ill., and is an Active Member of the A.A.N.A.

DEATHS

Stephanie Zazaske Smith, a member of the California Association of Nurse Anesthetists, died on June 10, 1949. She was a graduate of the Victory Memorial Hospital School of Nursing and studied anesthesia under Dr. Karl Connell.

Bessie Fay Hanson, a member of the Texas Association of Nurse Anesthetists, died on August 16, 1949. She was a graduate of the Hendrick Memorial Hospital School of Nursing, Abilene, Tex., and of the Barnes Hospital School of Anesthesia, St. Louis.

Maxine Leonard, president of the Utah Association of Nurse Anesthetists.

ABSTRACTS

SELDON, T. H.; FAULCONER, ALBERT, JR.; COURTIN, R. F., AND PINO, D.M.: Postanesthetic encephalopathy: The postulation of cerebral edema as a basis for rational treatment. Proc. Staff Meet., Mayo Clinic **24**:370-374, July 6, 1949.

"An abundant literature indicts anoxia as the primary cause of postanesthetic encephalopathy. A search of the literature for distinguishing characteristics of the histologic lesions following acute episodes of anoxia is disappointing. Also, there is little positive information regarding the pathogenesis of changes following these unfortunate accidents. Of concern to clinical anesthesiologists who are occasionally confronted with the problem of a comatose patient following an episode of anoxia is the fact that no rational treatment has been widely accepted or recommended.

"Reports on 2 patients observed by us and by Dr. K. B. Corbin, of the Department of Neurology and Psychiatry, are presented herewith. . . .

"Case 1.—A 27-year-old single white female presented herself on October 10, 1947 . . . . There was no record of any postoperative complications relative to the anesthesia in any of [four] previous surgical procedures . . . . Right radical mastectomy was done on October 17, 1949. Preoperative medication consisted of 1/150 grain (0.00043 gm.) of atropine sulfate and 1/6 grain (0.01 gm.) of morphine sulfate. A general anesthetic procedure was begun at 3:55 p.m. by the semiclosed method. The induction was smooth and uneventful and was accomplished with an 80:20 nitrous oxide-oxygen mixture and ether. Anesthesia was continued with ether and oxygen. Because of moderate phonation an intratracheal tube was inserted under direct vision . . . . Immediately after the excision of the breast, the method of anesthesia was changed to semiopen drop ether without added oxygen . . . . After two and one-half hours of anesthesia the operation was completed at 6:25 p.m. No cyanosis or other abnormal signs were noted during the anesthesia. A total of 5 ounces (about 150 cc.) of ether was used for the entire procedure . . . . The intratracheal tube was removed before the patient was returned to her room. About two hours after the completion of the operation the patient had not yet recovered from anesthesia but mumbled when stimulated, and appeared to be awakening. At 7 a.m., October 18, the patient was comatose and did not respond to any kind of vocal stimulus. At 9 a.m. she was still stuporous, but questioning produced some mumblings which appeared to be an attempt to answer the questions. At 10 a.m. she did not respond to questioning. At 1 p.m. she seemed momentarily to respond to questions by opening her eyes and with unclear mumbling, but then lapsed into coma again and could not be aroused. At 2 p.m. there was another momentary response to questioning and again the patient lapsed into coma and became increasingly restless. At this time, because of the cortical depression thought to be due to anesthesia, 5 mg. of desoxyn (desoxyephedrine) was given intravenously and almost immediately the patient had a generalized convulsion which was

controlled with intravenous injections of 2.5 per cent solution of pentothal sodium . . . . There were two more episodes of convulsions at 2:30 p.m., both of which were controlled with a few cubic centimeters of pentothal sodium given intravenously. At 3:15 p.m. the patient began to have constant purposeless movements of the arms and legs and required mechanical restraint. Neurologic examination at this time revealed a comatose patient who appeared very restless. Both pupils were dilated, the Babinski reflexes were present bilaterally, deep reflexes of the lower extremities were hyperactive, corneal reflexes were absent, examination of the fundus gave essentially negative results and the blood pressure was 135 systolic and 85 diastolic. At this time the carbon dioxide combining power of the blood was 39.1 volumes per cent, the blood sugar measured 130 mg. per 100 cc. and the blood urea 22 mg. per 100 cc. After consultation with the neurologic service it was decided to treat the patient for cerebral edema. At 7:30 p.m. 100 cc. of 25 per cent human serum albumin was injected intravenously. At 8 p.m. the patient apeared to be improved. The pupils reacted momentarily to light and the movements of the extremities seemed less violent. A saturated solution of magnesium sulfate was instilled rectally at this time. At 11:30 p.m. the patient appeared more restless and moved her head from side to side. Another 100 cc. of 25 per cent human serum albumin was injected intravenously. In less than five minutes after the injection the patient became quiet and appeared to sleep. At 7:30 a.m., October 19, the patient was still unconscious. One hundred cubic centimeters of 25 per cent human serum albumin was given intravenously and soon after this injection the patient's stare began to disappear. By 9 a.m. the pupils became reactive to light and the eyes followed the examiner. Restlessness and bilateral Babinski reflexes were still present. At 10:30 a.m. a spinal puncture was performed after the patient had been given 10 cc. of 2.5 per cent solution of pentothal sodium. The initial pressure of the spinal fluid was 20, expressed in centimeters of water. After 30 cc. of fluid had been withdrawn the pressure was 5 cm. The fluid was clear; the results of Kolmer and globulin tests were negative; the total proteins measured 30 mg. per 100 cc.; the lymphocytes numbered 27 per cubic millimeter, the polymorphonuclear leukocytes 9 and the erythrocytes many; and the colloidal gold curve was flat. At 7 p.m. the patient appeared much improved . . . . The results of the final neurologic examination on the twenty-first postoperative day seemed to be within normal limits and the patient was dismissed. Ten months later this patient returned to the Clinic for a surgical procedure on the other breast. At this time pentothal sodium by the intravenous route and nitrous oxide with oxygen were administered as the anesthetic agents. No untoward events occurred.

"Case 2.—A 50-year-old white male was to undergo operation for a carcinoma of the base of the tongue and insertion of radium on March 12, 1948. A successful dissection of the cervical glands with ligation of the right external carotid artery and left lingual artery had been accom-

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plished on February 19, 1948, with the patient under regional anesthesia combined with intravenous administration of a 2.5 per cent solution of pentothal sodium. The surgical procedure and postoperative convalescence were uneventful. Preoperative laboratory findings revealed nothing of significance except that the Hinton test gave positive results and the Kolmer test gave a very strongly positive reaction. In preparation for operation on March 12, 1948, 1/150 grain (0.00043 gm.) of atropine sulfate and 1 grain (0.065 gm.) of codeine sulfate were injected subcutaneously one-half hour prior to operation. Because of the previous surgical treatment and the extent of the carcinoma within the oral cavity, there was some obstruction of the airway. With trouble in depressing the mandible it was realized that intubation would be difficult. Induction with pentothal sodium given intravenously in order to obtain maximal anesthesia quickly, with subsequent cocainization of the pharynx and larynx, was felt to be the anesthetic method of choice. Induction was begun at 10 a.m. by using 2.5 per cent solution of pentothal sodium. After 750 mg. of pentothal sodium had been administered in two minutes the airway became completely obstructed owing apparently to laryngospasm. The time was noted to be 10:02 a.m. and an assistant was instructed to call out the time interval every thirty seconds to the anesthesiologist attempting the intubation. Cyanosis rapidly became marked but the jaw was sufficiently relaxed to allow the passage of a laryngoscope. Every effort to visualize the larynx during the next several minutes proved unsuccessful owing to carcinomatous involvement of the epiglottis and surrounding structures. The surgeon was requested to proceed immediately with a tracheotomy. This procedure was begun at 10:06 a.m. The region of the larynx was kept under direct vision by the anesthesiologist for a period of eight minutes, during which the patient was unable to obtain an inspiration of air. At 10:10 a.m., just eight minutes after the beginning of the laryngospasm, the patient's laryngeal orifice became visible and an intratracheal tube was inserted. Almost immediately the tracheotomy was completed and the remainder of the time the patient breathed through a tracheotomy tube. During this period of apnea the patient's pulse had become very weak and rapid. However, he responded quickly to resuscitation with oxygen, and was shortly able to maintain his own respiratory exchange. During the following hour the patient's color and pulse remained satisfactory though he made no movements of his extremities. Examination one hour after the anoxic episode revealed bilaterally present Babinski reflexes and marked ankle and patellar clonus. At 11:15 a.m. the patient began moving his extremities in a purposeless manner and it was necessary to apply physical restraint. This postanesthetic period was in marked contrast to the usual quiet recovery associated with pentothal sodium anesthesia. A complete neurologic examination at 3:00 p.m. revealed a patient in coma, moving the arms and legs purposelessly, occasionally in an athetoid manner and with some evidence of spasticity. When the eyes were forcibly opened, slight nystagmus

was apparent. There was no response to pin prick over the face, arms and trunk. The neurologist suggested that the patient had postanoxic cerebral edema. One hundred cubic centimeters of 25 per cent human serum albumin was injected intravenously at 3:15 p.m., 6:15 p.m. and 10:55 p.m., making a total of 300 cubic centimeters. Five minutes after the first injection a definite change in the patient's condition was noted. He was quiet and appeared to be recovering consciousness. By the time the second injection was given the patient was cerebrating almost normally and could count fingers. By 7 p.m. he was fully oriented for time, place and person. He could move his extremities normally and was sensitive to pressure over all extremities. At the time of the third injection he was alert and fully cooperative. The following morning the patient appeared fully conscious and responded to questions and demands accurately. He had a slight facial weakness. The Babinski reflex was still present on the left, but there was no apparent motor weakness. A subsequent anesthetic procedure using pentothal sodium intravenously and nitrous oxide-oxygen mixture administered through the tracheotomy tube was done to permit the removal of the carcinoma by electrocoagulation and insertion of radium.

"The 2 cases reported herein are believed to present many of the characteristic findings described in the literature as the sequelae of severe episodes of anoxia that have occurred during or after surgical anesthesia . . . . Inasmuch as human serum albumin is known to be a most effective agent for the reduction of cerebral edema, the conjecture cannot be avoided in the cases presented that the improvement observed was the result of coincident improvement in the cerebral edema following the anoxic episodes. We suggest, therefore, the following revision of our time-honored views regarding the nature of cerebral changes occurring after acute periods of anoxia in human beings. *Permanent damage to the brain as a result of acute cerebral anoxia not only is a function of the duration of the anoxic episode, but also, in the case of sublethal periods of anoxia, must be conditioned by the duration and severity of a period of postanoxic cerebral edema.* It is suggested that a considerable portion of the permanent cerebral damage reported in these unfortunate cases may be the result not of the initial insult, but rather of a period of untreated cerebral edema subsequent to the initial insult. If this hypothesis is accepted then it must follow that treatment should be directed toward the alleviation of the cerebral edema secondary to acute anoxic accidents. We suggest that the most effective treatment of this kind presently available is the intravenous administration of comparatively large doses of 25 per cent human serum albumin at frequent intervals. At present animal studies are in progress to determine whether a sound, experimental basis can be established for the hypothesis proposed. If these observations and comments are valid, then the advisability of similar treatment in such cases as acute poisoning with barbiturates and other depressant agents must be considered as adjuncts to other therapeutic measures. . . ."

BOOK REVIEWS

Fundamentals of Inorganic, Organic, and Biological Chemistry. By Joseph I. Routh, Ph.D., Associate Professor of Biochemistry, State University of Iowa. Ed. 2. Cloth. 346 pages, 73 illustrations. Philadelphia & London: W. B. Saunders Co., 1949.

This textbook for nurses is written with emphasis on biological chemistry. For purposes other than preliminary review, it is not particularly adapted to the needs of nurse anesthetists. A laboratory manual in ring binding is provided with the textbook.

Practical Physiological Chemistry. By Philip B. Hawk, Ph.D., President, Food Research Laboratories, Inc., Long Island City, New York; Bernard L. Oser, Ph.D., Director, Food Research Laboratories, Inc., Long Island City, New York; and William H. Summerson, Ph.D., Chief, Biochemistry Section, Medical Division, Army Chemical Center, Maryland. Ed. 12. Cloth. 1323 pages, 329 illustrations. Philadelphia: The Blakiston Co., 1947.

This excellent reference book has been completely revised, and many new subjects have been added. The volume is replete with information of value to anesthetists. From the many chapters and subjects covered, it is feasible here to point out only a few as illustrations of the material available.

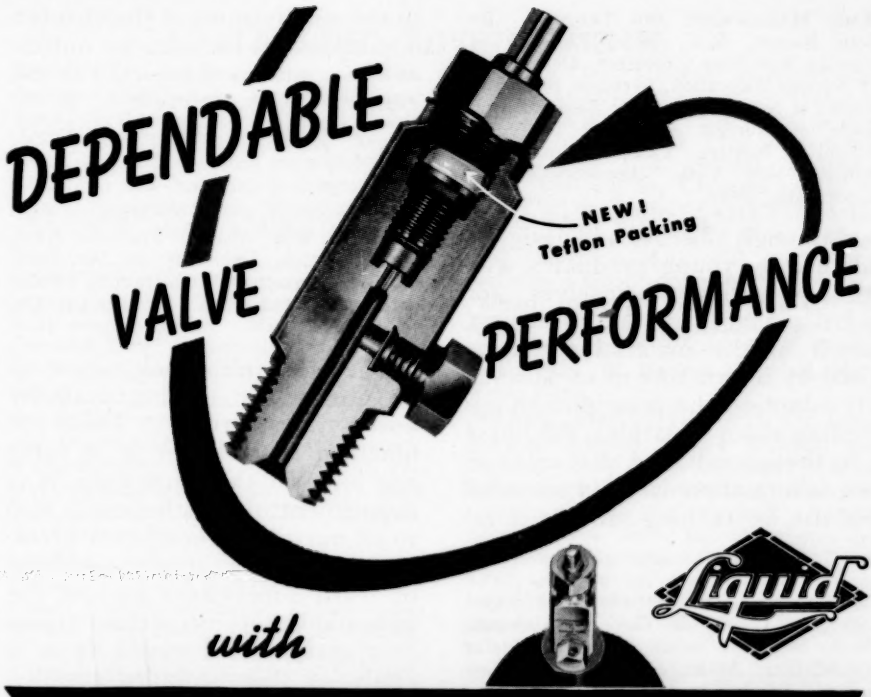
Chapter 1, which deals with the subject of the physicochemical properties of solutions, will be of great interest to anesthetists. In this chapter are included full explanations of osmotic pressure, surface tension, and hydrogen ion concentration. Experimental procedures are outlined after each subdivision of the chapter.

Muscle tissue, nerve tissue, blood and lymph, and the chemistry of respiratory exchange are other subjects that are presented in a detailed and lucid manner. Although the anesthetic agents themselves are not included, there is much information that should be useful to the anesthetist.

Each chapter is followed by a pertinent bibliography. Throughout the text, apparatus pertaining to each subject is pictured and explained. An appendix includes lists of reagents and solutions, table of acids, alkalies, food composition, logarithms, atomic weights, and other useful data. Indexed.

An Introduction to Physics in Nursing. By Hessel Howard Flitter, R.N., M.A., Head of Nursing Science Department, School of Nursing, University of Pennsylvania, Philadelphia; Instructor in Education, Hunter College of the City of New York; formerly Instructor of Physics Applied to Nursing, New York University, School of Education, New York City. 179 pages, 100 illustrations. St. Louis: C. V. Mosby Co., 1948. $3.25.

This book is bound in loose leaf plastic binding. The author has introduced his book as being "intended chiefly for the use of students and graduates of nursing and prenursing students in college, but it should also prove helpful to students of any allied ancillary medical science." It is with this latter group that student nurse anesthetists may find the book useful. All of the basic physical principles pertaining to nursing are presented with examples and graphic explanations. Each chapter is followed by a summary, guide questions for study, and references. Suggested laboratory exercises and a glossary are included in the appendix. Indexed.



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Ward Management and Teaching. By Jean Barrett, R.N., M.A., Professor of Nursing Education; Director, Department of Nursing Education, Syracuse University School of Nursing; formerly Associate Professor of Nursing Arts, Yale University School of Nursing. Cloth. 399 pages, 24 figures. New York: Appleton-Century-Crofts, Inc., 1949.

Although this book is designed for use by young graduates who are preparing themselves for ward management and teaching, much of the material could be used by instructors in anesthesia. By adapting the principles to operating room situations, the nurse anesthetist will find that most of the information is valid material for use in teaching student anesthetists.

Neurological and Neurosurgical Nursing. By C. G. de Gutiérrez-Mahoney, M.D., Sometime Fellow of the Rockefeller Foundation; Associate Professor of Neurology, Vanderbilt University School of Medicine, Nashville; Senior Neurosurgeon, United States Army Air Forces (Colonel MC,AUS); Director of the Neurological Division and Neurosurgeon-in-Chief, St. Vincent's Hospital, New York City; Neurosurgical Consultant, Fort Totten Army Medical Center, New York; and Esta Carini, R.N., B.S., formerly Head Nurse and Supervisor of the Neurological and Neurosurgical Services, Neurological Institute, Presbyterian-Columbia Medical Center, New York City; Clinical Instructor of Neurological and Neurosurgical Nursing, St. Vincent's Hospital, New York City. Cloth. 516 pages, 52 illustrations. St. Louis: C. V. Mosby Co., 1949. $5.75.

The review of the anatomy and physiology of the nervous system will be useful to anesthetists who are studying that special phase of the curriculum. Although anesthesia is not specifically mentioned, a reading of this text will add much to the understanding of neurosurgical problems by nurse anesthetists. An extensive bibliography follows each chapter and is divided by subjects according to the subdivisions of the chapter. The appendix includes an outline of the course and topics covered, supplementary references, a list of periodicals, and a glossary. Indexed.

Ward Administration. By Margaret Randall, R.N., M.A., Assistant Professor, Nursing Education, University of Minnesota. Cloth. 326 pages, 15 illustrations. Philadelphia & London: W. B. Saunders Co., 1949.

The title of this book may seem to preclude its being read by nurse anesthetists. However, much of the content is of value not only to the supervisor in a department of anesthesia but also to all nurse anesthetists. A greater appreciation of the problems of ward supervisors and of the importance of interdepartmental co-operation will result from a study of this book by anesthetists. The material has been carefully selected and co-ordinated and is presented in a manner that makes pleasant reading. Indexed.

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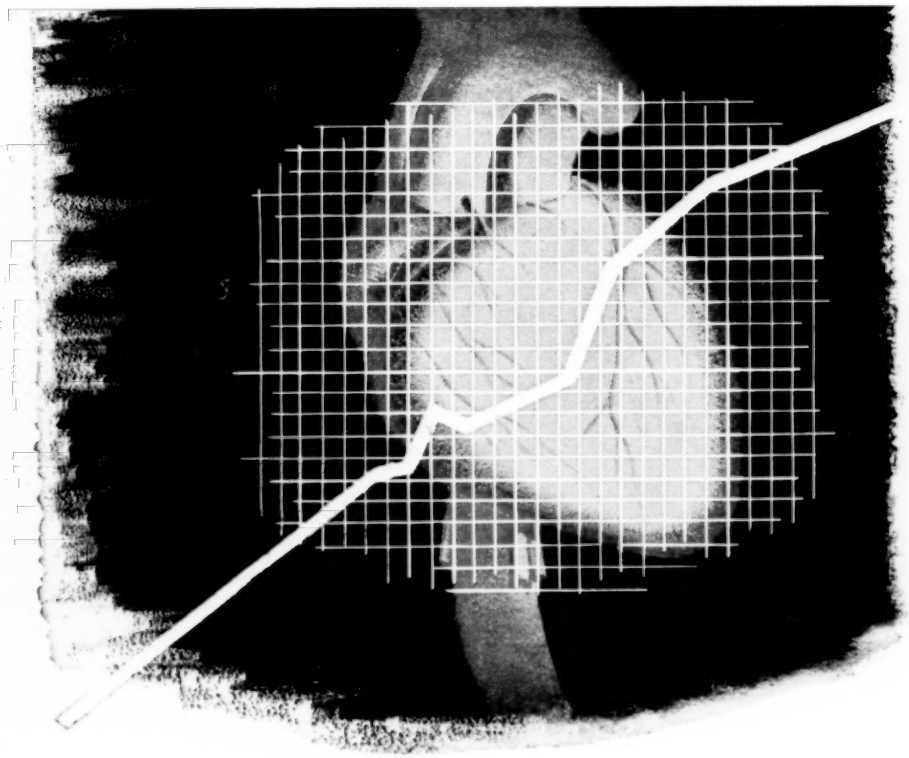

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